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SOIL SURVEY

OF

PORTAGE COUNTY

WISCONSIN

BY

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OF THE

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

AND

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INTRODUCTION

Before the greatest success in agriculture can be reached, it is necessary that the farmer should have a thorough knowledge of the soil upon his own farm. A soil may be well adapted to one crop, and poorly adapted to another crop. Clover will produce a vigorous growth and profitable yields on the average loam soil which contains lime and is in a sweet condition; but on a sandy soil which is sour, or in an acid condition, clover will not make a satisfactory growth. We may say, therefore, that failure is certain to be invited when such important facts are disregarded, or overlooked. The degree of success which it is possible to win on any farm is in direct proportion to the practical knowledge possessed by the farmer concerning the soil and its adaptation to crops. A thorough knowledge of the soil is as essential to the farmer as a knowledge of merchandise and business methods is to the merchant.

The State of Wisconsin, working in coöperation with the United States Department of Agriculture, is making a careful study of soils and agricultural conditions throughout Wisconsin, and is preparing soil maps and soil reports of all counties in the State. A soil map shows the location and extent of the different kinds of soil. Tracts of 10 acres and over are mapped, but often areas of even smaller extent are shown. The soil map is prepared by trained men, who go over a county thoroughly, and examine the soil by making a sufficient number of borings to a depth of 36 inches to keep account of all variations. A report is also made, to accompany and explain the map, and this is based upon a careful study of the soils within the region surveyed, and upon such other features as have a direct bearing upon the agriculture of the area.

It is the object of this survey to make an inventory of the soils of the State, and to be of practical help to farmers by lo-

cating and describing the different soils, by determining their physical character and chemical composition, and by offering suggestions for their management, based upon the work of the Soil Survey within the area, covered in the report, and upon the results of field tests made by the Experiment Station.

Soil fertility depends upon two factors: first, upon the physical characteristics of the soil, such as water holding capacity, workability, etc., and second, upon the chemical composition of the material composing the soil. The chemical composition depends upon the mode of origin of the soil, and the source of material from which the soil is derived.

Water holding capacity and other physical properties of soil all depend chiefly upon *texture,* which refers to the size of the individual soil grains, or particles. A coarse sandy soil, for example, will not retain moisture so long as a loam soil, or clay loam, because the finer the soil grains, the greater will be the total soil-grain surface area to which moisture may adhere. Texture is determined in the field by rubbing the soil between the thumb and fingers, and with experience one soon becomes expert at judging the size of soil grains. This field judgment is verified in the laboratory by a *mechanical analysis,* which is made by a simple method of separating soil grains into different groups, of which there are seven. These are known as clay, silt, very fine sand, fine sand, medium sand, coarse sand, and fine gravel.

A chemical analysis is also made of the soil to determine the amounts of various essential plant-food elements which are present. A chemical analysis shows whether the soil contains a large store of plant food, or only a small quantity, and it indicates which kinds of plant food will probably be needed first. The amount of organic matter in the soil is also determined, and tests are made to show conditions relative to soil acidity.

SOIL CLASSIFICATION.

Soils are grouped according to texture into soil classes, a soil class being made up of soils having the same texture, though differing in other respects. A fine sand, for example, may be light colored and of alluvial origin, while another fine sand may be dark in color and of residual origin, while a third fine sand may have been blown into sand dunes by the wind, yet all of these soils would belong to the same class, because the greater proportion of the soil grains have the same size or texture. Thus we may have different kinds of clays, loams, sands, etc., and the class to which any soil will belong depends upon the size of the individual soil grains of which it is composed, and not upon its color, origin, topographic position, or agricultural value.

SOIL CLASSES

Soils Containing Less Than 20% Silt and Clay

Coarse sand.—Over 25% fine gravel and course sand, and less than 50% of any other grade of sand.
Sand.—Over 25% fine gravel, Coarse and medium sand, and less than 50% fine sand.
Fine sand.—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.
Very fine sand.—Over 50% very fine sand.

Soils Containing Between 20–50% of Silt and Clay

Sandy loam.—Over 25% fine gravel, coarse and medium sand.
Fine sandy loam.—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.
Sandy clay.—Less than 20% silt.

Soils Containing over 50% of Silt and Clay.

Loam.—Less than 20% clay, and less than 50% silt.
Silt loam.—Less than 20% clay, and over 50% silt.
Clay loam.—Between 20 and 30% clay, and less than 50% silt.
Silty clay loam.—Between 20 and 30% clay, and over 50% silt.
Clay.— Over 30% clay.

Soils may be grouped in another way. Where soils are closely related through similar sources of the material from

which derived, mode of origin, topographic position, etc., so that the different soils constitute merely a graduation in texture of otherwise uniform material, such a group is called a *soil series*. It corresponds to the family which is made up of different individuals having the same parentage. The Miami series, for examples, includes light colored, glacial material where the soils have been derived largely from the underlying limestone, and the soils in the series range in texture from a clay loam to sand and gravel. The Plainfield series includes light colored soils in regions where no limestone is present, where the parent rock was largely sandstone, and where the material occurs as outwash plains or stream terraces. The soils in this series also have a wide range in texture. The name used for a soil series usually indicates the locality where that particular series was first recognized and mapped by the Soil we get the *soil type* which is the basis or unit of classifying and mapping soils. A *soil type* thus, is a soil which is uniform throughout its entire extent in texture, color, topographic position, and other physical properties, and having a distinct agricultural unity, that is, being adapted to the same crops, and requiring the same treatment. It is also uniform in the source of material from which it is derived, and the mode of origin which, taken together, determine the chemical composition. Since the soil type is the unit in classifying and mapping soils, and the basis upon which experimental work should be conducted, every farmer should be familiar with the soil types on his farm, and their leading characteristics.

SOIL SURVEY OF PORTAGE COUNTY, WISCONSIN

CHAPTER I

GENERAL DESCRIPTION AND HISTORY OF THE AREA

Portage County is located very nearly in the geographical center of the State of Wisconsin. It is regular in its outline and would be a square of 5 townships each way but for the

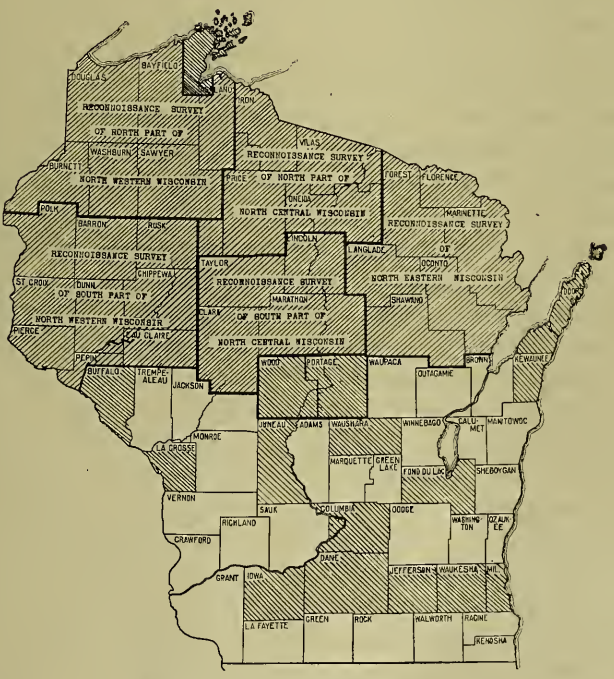

FIG. 1.—Sketch map showing area surveyed.

lack of the three townships which are a part of Wood County. The total area is 812 square miles, or approximately 519,680 acres.

Surface features.—The surface features of Portage county fall naturally into three divisions. Extending south from near the center of the north line of the county to the southern and southwestern boundaries is an extensive belt of level land. On the south this has a width of about 18 miles and extends north along the western border to the Wisconsin River. As it extends north it becomes narrower and on the northern boundary line is about 12 miles wide. This extensive plain-like tract is largely a water laid deposit consisting of stream terraces and outwash plains. Some very extensive marsh tracts occur within this belt. To the west from this level stretch, in the northwestern corner of the county is an area of residual country where the surface is undulating and the topography more mature than elsewhere in the county. The slopes are usually long and gentle. East of the level area, and covering about one-third of the county is a region where the surface is characteristic of a glacial region. Immediately bordering the level plain on the east is the terminal moraine of the late Wisconsin ice sheet forming a drainage divide, and back of this are drumlins, recessional moraines, high terraces, eskers, potholes, etc. making up a surface which ranges from level to rolling and hilly. This is the roughest and most irregular part of the survey. Some slopes are too steep to be cultivated.

Throughout the area of the moraine are to be found numerous small lakes where water has accumulated in the depressions of the uneven surface. Some of these lakes have no surface outlet, while others have. Still other depressions which were originally lakes are now marshy or swampy areas. In some of the depressions the accumulated organic matter has so far decayed as to form a soil of the nature of peat or muck. The forest growth is mainly tamarack, with some cedar. These swampy areas among the hills are all comparatively small. In the southwestern part of the county is a marshy area covering about 55,000 acres, a large part of which has been drained. Another large marsh occurs along Little Eau Plaine River in the northwestern part of the county, and some of this has also been reclaimed, but most of this marsh is in adjoining counties.

Throughout the plain-like region, differences in elevation are only slight. Stevens Point has an elevation of 1,086 feet, Bancroft 1,089 and Junction City an elevation of 1,142 feet above sea level. The average for the county is about 1,100 feet.

Water power.—The Wisconsin River is the largest stream in the county. Here water power is being extensively developed, and much more is available for development. The smaller streams also present some possibilities for water power development but on a much smaller scale.

Settlement.—In 1820 the area of the county, together with the whole of upper Wisconsin, was an unbroken wilderness. It, like several of the surrounding counties, was first visited by the white man for its pine timber. The Indians became alarmed at the rapid increase of lumbermen, and complained to the Government agents. In 1836 a treaty was made with the Menominee Indians for the cession of a strip of land 3 miles in width on each side of the Wisconsin River, from Point Bas, 40 miles up the river, to permit the operations of the lumbermen. This was offered for public sale in 1840, which opened the country, to the extent of this strip, to occupation and settlement. Early records show that the first settlers came principally from Illinois, Ohio, Pennsylvania, New York, and Maine, and a few from Canada. At present quite a large proportion of the population of Portage County is made up of Poles, Germans, Norwegians, and Swedes, who moved here mostly between the years 1850 and 1870. Many of them emigrated directly from Europe, while others came from the Eastern and Central States. In 1910 the population of Portage County was 22,253. Of this 71.9% was rural. There is an average of 27.4 people per square mile over the whole county.

Stevens Point is the county seat and largest town in the area. In 1910 it had a population of 8,692. This is the only place within the survey having a population of over 1,000. Among other towns and villages are Junction City, Plover, Arnott, Amherst, Bancroft, Rosholt, Almond and Amherst Junction.

Transportation facilities.—Four railway systems have lines extending into this area and fairly good transportation facilities are afforded all parts of the survey. The Soo Line (old Wisconsin Central) crosses the county from southeast to northwest, passing through Amherst, Stevens Point and Junction City. A branch of this road runs south from Stevens Point to Portage. The Green Bay & Western crosses the area from east to west through Amherst Jc., Plover and other points. It has a spur into Stevens Point from Plover. The C., M. & St. P. Ry.

traverses the extreme western side of the county, passing through Junction city. A branch of the C. & N. W. extends into the northeastern corner of the survey, reaching Rosholt.

Public roads.—Throughout the plain-like part of the area the wagon roads are naturally sandy, which is also true of some of the roads in the southeastern portion of the county. Throughout the remainder of the survey the soils are heavier and roads naturally better. In practically all communities good roads are being constructed, and there are now many miles of excellent highways. Rural free delivery routes reach all parts of the county and the telephone is in common use throughout the country districts.

Markets.—The towns within the area provide markets for considerable farm produce, but most of the surplus from the farms is shipped out. Livestock goes mostly to Chicago and Milwaukee as does also the potato crop. Dairy products find a market throughout the middle west.

SOILS

The region covered by the present survey, in common with a considerable area extending over several counties in central Wisconsin, owes the general character of its surface to several different processes of formation. The materials may be of glacial, residual, alluvial and possibly loessial origin. To these may be added the accumulation and decay of large amounts of vegetable matter in low places and the formation of Peat.

From a geological standpoint the county falls naturally into two divisions, and a straight line drawn across the area and passing through Plover and Custer will closely mark the line of contact between the two formations represented here. To the north of this line the surface rock consists of crystalline rocks made up chiefly of granite and gneiss. To the south of the line the bed rock consists largely of Potsdam sandstone.

The soils of glacial origin occur to the east of the terminal moraine which extends across the entire county from north to south in about the center of Townships Range 9 East. This moraine marks the border of the Late Wisconsin Glaciation. The topography of this region is of a rather irregular character which is typical of most glacial soils.

The portion of the county west of the terminal moraine is

within what is commonly called the driftless area or the area over which the glaciers did not extend. The soils of this portion are of two distinct sources of origin. Occupying the greater part of the southwestern part of the county, and extending north along the Plover and Wisconsin Rivers, is an extensive area of level, sandy land which is largely of water laid origin. In the lowest places the accumulation of decaying vegetable matter has given rise to extensive areas of peat. The second class of soil is found in the extreme northwestern quarter of the county. Here the soils are largely of residual origin, having been formed from the weathering of the underlying crystalline rocks.

All rock formations have contributed to a greater or less extent in the formation of the soils of the county. In sections where sandstone is the underlying rock, the soils are found to be derived in part from crystalline rocks and in part from sandstone rocks. This has been brought about by glacial action, through the movement of the ice sheet from a region of crystalline rocks to the north and east, and moving to the southeast carrying with it crystalline material. Since first deposited, the various soil materials have been modified by various agencies such as running water, frost, wind, and the accumulation and decay of vegetable matter. This material has been classified into 14 soil series and 24 soil types, each of which has characteristics by which it can be readily recognized.

The Marathon series consists of light colored upland soils in the unglaciated section where the soil has been formed chiefly from the weathering of underlying crystalline rocks. It is confined to the northwestern portion of the county west of the Plover River and north and west of the Wisconsin River. Two types, the silt loam and fine sandy loam, were mapped.

The Colby series includes light colored upland soils within the region covered by an early glaciation and also in the driftless area. Its chief characteristics are quite level topography, a mottled and heavy subsoil and poor drainage conditions. The silt loam and fine sandy loam were mapped in this county and they are closely associated with the Marathon soils. The Colby series differs from the Marathon chiefly in being lower, more nearly level, and having a strongly mottled subsoil. It may be of the same or slightly different origin.

The Kennan series comprises the light colored, upland timber soils within the glaciated region where the material has been derived largely from crystalline rocks. This is one of the most Important series in the county and included much of the best farming land in the area. It is mostly confined to the eastern half of the county to the east of the terminal moraine. Two types, the loam and fine sandy loam were mapped.

The Antigo series comprises light colored, timbered, alluvial soils which occur as stream terraces, filled in valleys or outwash plains above the present flood plain where the parent material has been derived largely from crystalline rocks. This series is found chiefly associated with the Kennan series throughout the eastern half of the county. Antigo loam and fine sandy loam were mapped.

The Plainfield series comprises light colored, timbered, alluvial soils where the parent material was largely sandstone, but with which some crystalline material has frequently been mixed. The soils of this series are mostly light textured. They are confined to the Wisconsin River valley in the southwestern part of the county. Two types, the sand and sandy loam, were mapped.

The Waukesha series comprises dark colored, alluvial soils which were sparsely timbered, and where the material occurs as stream terraces, filled in valleys or outwash plains. It is quite similar to the Antigo and Plainfield soils, and the parent material has doubtless come both from sandstone and crystalline rocks. Three types, the sand, sandy loam and fine sandy loam were mapped.

The Dunning series comprises low-lying, dark colored soils underlain by light colored material. The soil is poorly drained and the parent material was largely sandstone. The material is always acid. The sand and sandy loam of this series were mapped.

The Whitman series comprises low-lying, dark colored soils derived chiefly from crystalline rock material. The material may be alluvial or it may occupy poorly drained depressions in the upland. Soils of this series are always acid. The heavy types usually predominate. Whitman silt loam is the only type of this series mapped in Portage County.

The Boone series comprises light colored, upland soils which have been derived chiefly from the weathering of Potsdam sand-

stone. The Boone soils are very limited extent in this survey and are confined to the west central portion of the county. Boone sandy loam is the only type of this series mapped.

The Coloma series consists of light colored upland timbered soils derived largely by glaciation from sandstone formations. Some granitic material has also been mixed with the sandstone drift through glacial action. Sandy types predominate in this series. Two types, the sand and sandy loam were mapped in this area.

The Vesper series includes light colored upland soils where the surface is usually level, or nearly so, and where the subsoil consists of sandstone rock or sandy material derived from sandstone. Natural drainage is poor except on the rolling phase, and the soil is acid. The silt loam is the only twpe mapped.

The Genesee series comprises light colored, first bottom lands which are subject to annual flooding. The series is of limited extent and of minor importance in this county. The fine sandy loam and silt loam were mapped.

Peat consists of accumulations of vegetable matter in varying stages of decomposition, with which there has been incorporated a small amount of mineral matter. The typical Peat and a shallow phase were mapped.

The following table shows the actual and relative extent of each of the soils mapped in Portage County.

AREA OF DIFFERENT SOILS

Soil	Acres	Per cent
Peat	66,560	16.4
Shallow phase	18,624	
Plainfield sand	78,592	15.1
Coloma sand	68,480	14.2
Shallow phase	5,440	
Colora sandy loam	51,840	10.9
Shallow phase	4,928	
Plainfield sandy loam	33,536	6.4
Dunning sand	23,232	4.5
Kennan fine sandy loam	22,976	4.4
Colby fine sandy loam	22,720	4.4
Waukesha sand	21,824	4.2
Dunning sandy loam	15,232	2.9
Kennan loam	13,632	2.6
Marathon fine sandy loam	13,440	2.6
Colby silt loam	12,800	2.6
Rolling phase	640	
Antigo fine sandy loam	10,238	2.0
Waukesha sandy loam	5,440	1.0
Antigo loam	5,312	1.0
Whitman silt loam	5,248	1.0
Genesee fine sandy loam	5,248	1.0
Genesee silt loam	4,544	.9
Marathon silt loam	3,008	.6
Vesper silt loam	832	.5
Rolling phase (Knox silt loam)	1,536	
Boone sandy loam	1,920	.4
	519,680	

CHAPTER II

GROUP OF HEAVY SOILS

COLBY SILT LOAM

(Including the rolling phase)

Extent and distribution.—The Colby silt loam occupies a total area of about 21 square miles and is confined chiefly to the northwestern part of the county largely in Township 24 N., R. 6 E. It joins very extensive areas of similar soil in Wood County.

Description.—The surface soil of this type to an average depth of 8 inches consists of a light grayish brown silt loam, which has a very high content of silt and a smooth feel. The subsoil consists of a heavy, compact, drab or bluish silt loam strongly mottled with yellow, brown, and red. This grades into mottled silty clay loam at about 2 feet, and the heavy material usually extends to a depth of over 3 feet. In some places there is found in the subsoil a layer of red, sticky sandy clay loam in which angular rock fragments are found.

Some variations occur in this soil. A portion of the type differs from typical Colby silt loam in being within the unglaciated region so that the subsoil at least is largely of a residual origin. The area in sections 19 and 20 (T. 24—R. 7 E.) has a subsoil of sticky reddish clay. This red clay is found at depths varying from 8 to 36 inches beneath the surface; however, in certain localities it appears on the surface. The subsoil of all the Colby silt loam in Portage County is more variable than that found in the large areas of the same type of soil in Wood and Clark Counties. It ranges from a sticky fine sandy loam to heavy clay loam, however, all of it is very tight and impervious.

Topography and drainage.—The surface of the Colby silt loam varies from level to gently rolling. Where it is level or

only very gently rolling it has been mapped as typical soil, but where there is sufficient slope to insure fair to good surface drainage, a separation has been made on the soil map and the better drained portion referred to as the rolling phase of the Colby silt loam. The rolling phase is of very limited extent. The only difference between the two phases is that of topography. The drainage conditions on the typical soil are poor and the land is apt to be cold and wet in the spring and after heavy rains.

Origin.—This type of soil has probably been formed from two sources. The surface soil came in part from the weathering of a thin glacial deposit of the early Wisconsin Ice Sheet; while the deep subsoil, and in places some of the surface, is residual, having been derived from the underlying crystalline rocks. As there is no limestone in this section, a very strong acidity prevails.

Native vegetation.—The original stand of timber consisted of maple, birch, elm, basswood, hemlock, pine, and balsam.

Agricultural development.—Most of the Colby silt loam is cleared and under cultivation. It is a strong, productive soil and when properly managed produces very good yields of all the common farm crops.

The type is well adapted to general farming and dairying and most of it is well improved. The typical soil in its undeveloped stage is inclined to be rather wet but when cleared and cultivated the drainage conditions improve somewhat. However, tile drains are needed in order that the soil may be permitted to drain out and warm up earlier in the spring.

The chief crops grown are clover and timothy for hay, oats, barley, corn and potatoes. On the best drained areas very good yields are usually secured. The type is especially well adapted to grasses, and portions too wet to be tilled in the spring provide excellent pasture.

This soil is more difficult to handle than any of the other types of the county and care must be exercised to plow when moisture conditions are most favorable. With care a mellow seed bed can be secured with but little difficulty. Fall plowing is practiced on many farms and this is advisable.*

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* For chemical composition and management of this soil see page 23.

MARATHON SILT LOAM

Extent and distribution.—The Marathon silt loam is not an extensive soil in this county. It is confined to the northwestern corner, chiefly Carson Township, with a few small patches in Eau Plaine Township. The total area is about 3,000 acres.

Description.—The surface soil of this type to an average depth of 10–12 inches consists of a brown or dark yellowish-brown silt loam. Granitic rock fragments of irregular shape and small size are scattered quite thickly on the surface in places and some fragments also occur through the soil section. The subsoil is of a lighter yellowish-brown color than the surface and in texture is a compact silt loam which at from 20–30 inches becomes a reddish or yellowish heavy silty clay, or sandy clay loam containing small residual granitic fragments of various colors. A layer of fine sandy loam or sandy loam may occur in the heavy residual subsoil in some places. The underlying formation which is entirely crystalline rock is usually found at a depth of from 3 to 6 feet. In some places the subsoil consists simply of disintegrated rock which is often quite highly colored.

Topography and drainage.—In topography this type of soil varies from undulating to gently rolling. The surface is always sufficiently rolling to insure excellent surface drainage.

Origin.—The surface soil of this type is probably largely residual but in places it has a loess-like appearance and may have been deposited in part by wind action. The subsoil is principally residual, having been formed by the weathering of the underlying rocks which are chiefly very coarse grained granites. While a few glacial boulders are found scattered on the surface, the effect of glaciation over this region was too slight to influence to any extent the formation of the soil.

Native vegetation.—The original stand of timber was chiefly hardwood mixed with hemlock, balsam and pine. The hardwoods predominated in nearly all cases, but in a few areas the pine made up the greater proportion of the tree growth. Most of the timber has been removed, and in places a second growth of poplar has sprung up.

Agricultural development.—Because of its limited extent, this type is of but small agricultural importance, but the greater part is under cultivation and highly improved.

This soil is devoted to general farming with dairying as an important branch. It is a strong productive type and well suited to all general farm crops. Yields run about as follows:—corn about 50 bushels per acre, oats 30 to 50 bushels, barley 30 to 35 bushels, potatoes 150 to 200 bushels, and hay 1½ to 2 tons per acre.

Fall plowing is common for this soil. It is more difficult to cultivate than soils of lighter texture. The presence of rock fragments also makes cultivation more difficult than where these are not found. This soil is acid and but little if any effort is being made to correct this condition.*

VESPER SILT LOAM

This soil is of very limited extent, occupying a total area of less than 2 square miles. It is found chiefly to the southwest of Stevens Point in the Town of Linwood.

The surface soil of the Vesper silt loam, extending to an average depth of 12 inches, is a light-brown to brown silt loam, underlain by buff or mottled drab or yellow silt loam. At a depth of 18 to 22 inches a layer of reddish-brown or mottled, compact silty to sandy clay loam, 2 to 6 inches thick, is encountered. Below this the subsoil consists of either a mottled drab and yellow sandy loam or a yellowish sticky sand. Sandstone occurs in this lower subsoil at or near the depth of 3 feet and fragments and slabs of this rock are common on the surface and through the surface soil, but not in sufficient abundance to render the soil stony.

The topography is level to slightly sloping. Both surface drainage and underdrainage are slow and imperfect. The original timber growth included oak, elm, maple, basswood and white pine.

The type is largely under cultivation. The principal crops are hay and oats. Part of the type is used for pasture and a smaller acreage for growing corn. Potatoes are grown to a small extent, but the soil is rather heavy and wet for this crop. Hay yields 1 to 1½ tons per acre and oats about 35 to 45 bushels.

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* For discussion on chemical composition and management of this soil see page 23.

This soil occurs in a region devoted largely to general farming and it is utilized chiefly for this purpose. It is more difficult to handle than soils which have a somewhat rolling surface and better drainage. No commercial fertilizers are used, and little stable manure is available.

VESPER SILT LOAM, ROLLING PHASE*

(Knox Silt Loam)

This soil is confined to a few small areas southwest of Stevens Point, chiefly in Linwood Town. It occurs associated with Vesper silt loam. It has a total area of about 1,500 acres.

The soil to a depth of 8 or 10 inches is a light-brown, or when dry a grayish-brown, silt loam. This is underlain by a buff-colored silt loam. The subsoil is very similar to that of the Vesper silt loam except that the mottling is less pronounced and often entirely lacking. In the western part of secs. 18 and 19, T. 23 N., R. 7 E., a small area of fine sandy loam is included with the silt loam. Except for these variations the type is quite uniform.

The surface has a gently rolling to rolling topography, and both surface drainage and underdrainage are good. The original timber growth consisted of oak, maple, and white pine. The soil is considered productive and especially adapted to small grains and hay and pasture grasses. A fairly large proportion of the type has been cleared and put under cultivation. The principal crops are oats and hay, with a smaller acreage of corn and potatoes. Oats ordinarily yield from 35 to 50 bushels per acre, hay 1½ to 2 tons, potatoes 150 bushels or more, and corn 30 to 40 bushels.

This soil is not difficult to handle, and a good seed bed can be worked up with little difficulty. No commercial fertilizers are used and green manuring is seldom practiced. The supply of stable manure is inadequate. Little attention is given to selecting crop rotations best suited to the soil.

* On the accompanying soil map this phase is shown as Knox silt loam.

CHEMICAL COMPOSITION AND FERTILITY OF HEAVY SOILS

The heavy soils of the Colby, Vesper and Marathon series have a good supply of the mineral elements phosphorous and potassium.

Phosphorus.—The total amount of phosphorus in an acre to a depth of 8 inches varies from 1,100 to 1,400 pounds. This would be sufficient for 100 to 150 crops if all were available, but it is never practicable to secure good growth from such soils after the total phosphorus has been reduced to six or eight hundred pounds and better results are always secured when the total phosphorus content of this layer of soil is retained at from 1,500 to 2,000 pounds per acre 8 inches. A farmer on this land, therefore, should adopt plans which will maintain the present supply of this element rather than attempt to draw on it even for a short number of years. The availability of this element requires a good supply of organic matter.

Potassium.—The element potassium exists in very much larger amounts in these soils than does the element phosphorus—in fact they contain on the average over 30,000 pounds of this element per acre to a depth of 8 inches. This is a sufficient supply to meet the demands of heavy crops for several hundred years. The entire problem with reference to patassium, therefore, is connected with its availability. When a good supply of active organic matter is present it can be assumed that there is sufficient potassium made available for practically all crops grown on this land. In the case of a few special crops requiring unusually large amounts of this element, such as cabbage and tobacco, the use of potash fertilizers may in some cases be profitable. The system of farming followed will also influence the potassium supply. A large part of this element goes to the stalks and straw of the plant so that if the hay and rough forage is fed the greater portion of this element is returned to the land in the manure—differing radically from phosphorus which goes to the grain and is, therefore, more likely to be sold.

Organic matter and nitrogen.—Compared with prairie soils which have shown a lasting fertility, these soils are distinctly low in organic matter and nitrogen. In fact, most upland soils of wooded regions are low in organic matter. When stock raising is practiced manure is available and is of course good as

far as it goes, but on comparatively, few farms is there sufficient manure produced to maintain the organic matter in soils of this character, and other means should be used to supplement the barnyard manure. Green manuring crops should be used as far as possible, turning under the second crop of clover whenever this can be done rather than using it for pasture. Seeding clover in corn at the last cultivation will secure good growth when the season is favorable. Cultivated ground when used for pasture should not be grazed closely.

Nitrogen is perhaps the most essential element of plant food and large amounts are used by all crops. It exists only in the organic or vegetable matter of the soil, there being none whatever in the earthy material derived from the rocks. Soils which are low in organic matter are, therefore, also low in nitrogen. By all means the cheapest source of this element is through the growth of legumes such as clover, alfalfa, soy beans, etc., which collect it from the atmosphere. When these crops are turned under they contain an abundance of this element. When fed to stock a portion only is returned to the land. But when land of the character of that under discussion is used for mixed farming so that at least one-fourth produces a good crop of clover or alfalfa each year the supply of nitrogen can be maintained on a dairy or stock farm but where any considerable portion of the land is in crops which are sold entirely one-third or more would have to be in some legume crop to maintain the nitrogen supply.

Acidity and liming. Since all of these soils were formed from rocks not containing lime carbonate they are essentially all acid. The degree of acidity varies from one which would require 1,000 to that which would require 5,000 pounds or more lime to correct. This acidity is not in itself a direct detriment to the growth of most farm crops, but does interfere with the growth of the best legumes. Clover will do well while this soil is new even though acid, but after this land has been cropped a number of years the acidity should be corrected to secure the best results with medium red or mammoth clover. Alfalfa is very sensitive to acidity and lime in some form must be used to secure good results with this crop even on new land.

Crops.—Marathon silt loam and the rolling phase of Colby and Vesper silt loams are adapted to a wide range of crops in-

cluding corn, root crops, grasses and small grains. The typical Colby silt loam and Vesper silt loams, however, are not so well adapted to such a range of crops because their level surface and heavy subsoil give them rather inadequate drainage. They are, however, well adapted to grains and grasses. Fields on the Colby and Vesper soils having good slope and surface drainage can be made to produce good corn by careful management. The soils o fthis group are well adapted to dairy farming on account of their unusual fitness for the growing of hay and pasture.

CHAPTER III

GROUP OF MEDIUM HEAVY SOILS

KENNAN LOAM

Extent and distribution.—The Kennan loam is confined almost entirely to the eastern tier of townships where it is associated with other soils of the Kennan, Antigo, and Coloma series. It has a total area of about 21 square miles, and is one of the best soils in the county.

Description.—The surface soil to a depth of 14 to 18 inches is a light brown or buff colored loam to silt loam underlain by a brown compact gravelly sandy loam or sandy clay which changes gradually at 24 to 30 inches or below into a brown or yellowish sand and gravel.

Over virgin areas the surface few inches are dark due to an accumulation of organic matter, while over plowed areas this material has been incorporated with the surface soil to the depth of plowing with a resultant grayish-brown color. On the typical soil a moderate number of stones and boulders are found on the surface and through the soil, but these are not so numerous as to interfere seriously with cultivation. A variable per cent of gravel occurs in the surface and upper subsoil in places, but such material is more often found in the lower subsoil. The most important variation in this soil is in connection with its stoniness. Where stones and boulders were found to be sufficiently numerous to interfere materially with cultural operations such tracts were indicated separately on the soil map. In a few places the land is so rocky that the removal of the stones would be too costly to be carried out, and the land will be used largely for pasture. Such tracts, however, are of very limited extent.

Topography and drainage.—The topography of this soil varies from gently rolling to rolling, and while the type occurs on

some of the largest and highest hills, steep or abrupt slopes are uncommon. Practically all of the land can be placed under cultivation except the extremely stony tracts mentioned above. The drainage conditions are excellent.

Origin.—The Kennan loam is a glacial soil formed from material left by the Late Wisconsin Ice Sheet. The rocks are nearly all granitic and the soil is in an acid condition.

Native vegetation.—The original stand of timber was maple, hickory, birch, oak, and a small amount of white pine.

Agricultural development.—This is considered one of the strongest and most fertile soils in the county and is well adapted to general farming and dairying which are the important lines followed. Most of the land is improved and under cultivation. Good yields of all the ordinary farm crops can be produced. Hay is an important crop, and good pastures are readily maintained. Large yields of corn and potatoes are common. Small farm orchards, especially of apples, do well, and strawberries and bush berries make very satisfactory returns.

This soil is somewhat heavier to work than lighter members of the Kennan series, but a good tilth can be secured without difficulty. The heaviest portion of the type occurs chiefly as broad topped hills south of Palonia and in the vicinity of Benson's Corners and Amherst. More care must be exercised in cultivating this heavy phase than the remainder of the type.*

ANTIGO LOAM

Extent and distribution.—This type is mapped principally in the eastern part of the county, chiefly in the towns of Alban, New Hope and Amherst. It occurs in areas mostly less than 1 square mile in extent. The total area is approximately 5,000 acres.

Description.—The Antigo loam to an average depth of 12 inches consists of a brown or buff loam. The surface soil may be underlain by several inches of lighter colored sandy loam or loam, or may grade into a brown, compact, gravelly clay or sandy loam, which changes abruptly at 24 to 30 inches or below into brown coarse sand and fine gravel, with frequent layers of

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*For discussion on chemical composition and management of this soil see page 36.

coarser gravel interbedded. This type is free from large stones and boulders, but gravel and small rounded cobbles occur quite generally in noticeable quantities on the surface and through the surface soil.

A silty variation of the Antigo loam occurs on the high glacial terrace along the valley of Waupaca River, in townships 22 and 23, range 10. If this soil were of sufficient extent it would be mapped separately as the Antigo silt loam. The soil of this variation to an average depth of 8 inches consists of a grayish-brown silt loam resting upon a buff-colored silt loam, which changes at a depth of 14 to 16 inches to a light-brown compact silty clay loam. This heavy subsoil may continue to a depth of over 36 inches or it may change abruptly at any depth below 24 inches to a brown coarse sand mixed with well-rounded gravel. Over the greater part of its extent this soil is quite uniform. In sec. 1, T. 22 N., R. 10 E., just south of where the Minneapolis, St. Paul & Sault Ste Marie Railway crosses the eastern boundary of the county, the surface soil is decidedly darker than typical.

Topography and drainage.—The type occupies flat or slightly undulating terraces, which are frequently dotted with pits and potholes. The natural surface drainage and underdrainage are good. In places where the terraces are badly eroded and where the potholes are so numerous as to produce a rolling surface, the soil is mapped with the Kennan loam, being separated chiefly because of the difference in topography.

Origin.—The Antigo loam is an alluvial soil having been deposited as outwash plains and as stream terraces. Many of these terraces are high above the bed of the present day streams. The material has been derived largely from granitic rocks and the resulting soil is all acid.

Native vegetation.—The original timber growth consisted of oak, maple, elm, and hemlock with some white pine. Practically all timber has been cut.

Agricultural development.—Antigo loam is a desirable soil agriculturally. By far the greater part of it is under cultivation and quite highly improved.

The principal crops grown, named in the order of their importance, are hay, oats, potatoes and corn. The type of agriculture most largely followed consists of general farming, with

dairying and patato growing as the two leading branches. Hay on the average yields 1½ to 2½ tons per acre, oats 40 to 60 bushels, potatoes 100 to 200 bushels, corn 30 to 60 bushels, and silage 12 to 16 tons. Little difficulty is experienced in working up a good seed bed. Stable manure is practically the only fertilizer used, but in a few instances green manuring has been practiced.

Land values on this type range from $60 or $75 to about $100 an acre, the price depending upon the location of the farm, the acreage under cultivation, and the improvements.*

KENNAN FINE SANDY LOAM

Extent and distribution.—The Kennan fine sandy loam is one of the important and extensive types of the county. It is confined chiefly to the eastern portion of the county, the largest tracts being found east of the Plover River and north of the Soo Railway line. With it are associated other soils of the Kenman and Antigo series, and in the low places small areas of past are common.

Description.—The surface soil to an average depth of 14 inches consists of a buff colored or yellowish-brown heavy fine sandy loam of a friable structure. The surface 1 or 2 inches of virgin areas is dark gray in color due to the accumulation of considerable organic matter. Over plowed areas this material has been distributed through the surface soil to the depth of plowing with a resultant grayish brown color. The surface soil grades into a subsoil of brown or reddish-brown compact sandy loam, fine sandy loam or sandy clay which passes at 20 to 24 inches or below into gravelly sandy loam or gravelly sand of the same or lighter color. A small amount of gravel frequently occurs in the surface soil and upper subsoil, but this material is concentrated mainly below the heavy stratum in the subsoil. A few stones and boulders of moderate size are found here and there over the surface of the typical soil and through the soil profile, but not in sufficient numbers to interfere seriously with cultivation.

This soil is quite uniform throughout its extent, except that there is a wide variation in the stoniness. In places the stones

* For discussion on chemical composition and management of this soil see page 36.

are so large and numerous as to seriously interfere with cultivation, and to remove them would be very difficult and expensive. Such extremely stony areas have been indicated on the map by means of symbols. In these stony tracts there is more gravel in the subsoil than where but few stones are found.

Topography and drainage.—The surface of this soil ranges from gently rolling to rolling, and because of the surface features and the gravelly condition of the subsoil, the natural drainage is good. The soil retains moisture well and therefore suffers less from drought than most other soils of the county.

Origin.—The Kennan fine sandy loam is a glacial soil of the Late Wisconsin Glaciation. It has been formed largely from granitic rocks and is in an acid condition.

Native vegetation.—The original timber growth consisted chiefly of maple, birch, basswood, oak, hemlock, balsam, and pine. Most of the good timber has been cut, and the land which is not under cultivation is either covered with a second growth of poplar and other trees or with trees of but little value except for cord wood.

Agricultural development.—The greater proportion of the Kennan fine sandy loam is improved and under cultivation. It is one of the most desirable soils in the County and is well adapted to general farming, and especially to the dairy industry. The chief crops grown and the average yields obtained are potatoes 150 bushels, corn 35–50 bushels, rye 20 bushels, oats 30–40 bushels, barley 25 bushels and hay about 1½ tons per acre. Apples and small fruits are grown on many farms, but usually for home use only.

Where boulders are not plentiful this soil is comparatively easy to handle. It can be cultivated under a rather wide range in moisture and good tilth and maintained without difficulty. A rotation quite common on this consists of corn or potatoes, followed by a small grain seeded to timothy and clover. Hay is usually cut two years before the land is again plowed for a cultivated crop. The field may be pastured for a year before being plowed. Stable manure is most often applied to sod land.

Farms of this type of soil sell at from $40–$75 or more per acre depending upon amount of land cleared, on the improvements and the location.*

*For discussion of chemical composition and management of this soil see page 36.

VIEW SHOWING TYPICAL SURFACE FEATURES OF KENNAN FINE SANDY LOAM
This is a good general farming soil. There are over 36,000 acres of this kind of land in Portage County.

VIEW SHOWING MORAINIC NATURE OF VILAS SANDY LOAM
This soil is lighter in texture and rougher in topography than the Kennan fine sandy loam shown above. There are over 55,000 acres of Vilas sandy loam in Portage County.

COLBY FINE SANDY LOAM

Extent and distribution.—This soil is found only in the northwestern part of the county chiefly in the towns of Eau Plaine, Carson, and Dewey. It covers a total area of approximately 35 square miles, but no one continuous tract is over 5 or 6 square miles in extent

Description.—The surface of this type to an average depth of about 8 inches consists of a dark brown to grayish-brown fine sandy loam or sandy loam, which contains a fair amount of organic matter. This is underlain by a yellow or yellowish-brown fine sandy loam to a depth of over 3 feet. Sticky layers of clay or of compact fine sand or sandy loam occur in the subsoil. Angular rock fragments occur on the surface or are mixed with the soil. The underlying crystalline rocks are sometimes encountered within the 3 foot section, while in other places partly weathered rock occurs at about 3 feet from the surface. A marked variation is found in the subsoil in Sections 28, 29, 30, 32, and 33 in Township 24 N., R. 7 E., where a heavy red clay is found at about 12 to 36 inches beneath the surface. Variations in stoniness also are found, the most stony areas being indicated on the soil map by symbols.

Topography and drainage.—The surface varies from level to gently undulating or sloping and the natural drainage is deficient. The type is found as gentle slopes or level strips bordering streams, swamps or drainage swales, which are kept more or less permanently wet by springs, seepage and run-off from higher lying land. Some of this soil includes elevated areas of fine sandy loam which have very gently undulating to flat topography. While these areas are better drained than the low lying tracts, they are still deficient in this respect.

Origin.—This type of soil is largely of residual origin, and in this respect differs from typical soils. While the region was traversed by an early ice sheet, the resulting influence on the soils was very slight. All of the material came from crystalline rocks and the soil is now quite strongly acid.

Agricultural development.—Probably about half of the type is cleared and improved. The better drained areas are cultivated to the general farm crops common to the region, and the wettest portions are used for pasture. The best crops are se-

cured during dry years. The poorly drained condition makes the soil cold and backward in the spring. The chief crops grown are hay, oats, corn and some potatoes. Average yields are somewhat lower than on higher lying better drained soil of the same texture.

The methods of farming followed are not those best adapted to permanently improve the soil, but little attention being given to rotations and tillage best adapted to it.*

MARATHON FINE SANDY LOAM

Extent and distribution.—The Marathon fine sandy loam is confined to the northwestern portion of the county, being found chiefly in Eau Plaine and Carson Townships. It covers an area of about 21 square miles.

Description.—The surface soil of this type to a depth of 10 inches consists of a dark brown to grayish-brown fine sandy loam. The subsoil consists of a yellowish-brown fine sandy loam to 36 or 40 inches. A layer of sandy loam or loamy fine sand on sticky sandy clay and crumbly disintegrated rock may be found below 2 feet in some borings. The subsoil often varied in color depending upon the color of the rock from which derived. Granitic rock fragments and quartz pebbles of small size are often scattered on the surface. The soil is subject to numerous variations, all of which are limited in extent.

Topography and drainage.—The topography is undulating to gently rolling. The rather sandy subsoil and the rolling surface make the drainage conditions nearly perfect except in a few of the more nearly level areas.

Origin.—This soil has been formed largely from the weathering of the underlying crystalline rocks, and the variations in texture are due to the difference in the rock from which the soil was formed. While this is considered to be a residual soil, the region has undoubtedly been at least slightly effected by glacial action, but this has had no appreciable effect on the soils.

Native vegetation.—The original timber growth consisted largely of hemlock, balsam and maple, with which there was varying amounts of white pine.

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* For discussion of chemical composition and management of this soil see page 36.

Present agricultural development.—A large proportion of this soil is improved and under cultivation. It is of good quality and adapted to all general farm crops grown in this region. Small grains, corn, and potatoes do well, and hay and pasture can be furnished so that dairying is coming to be the leading industry. The soil dries out earlier in the spring, it is easier to cultivate and work and it can be worked under a wider range of moisture conditions than the heavier soils.*

ANTIGO FINE SANDY LOAM

Extent and distribution.—The Antigo fine sandy loam is of limited extent and occurs in areas of from a few acres to about one square mile in extent. It is confined largely to the east central part of the county, with the largest tracts located in sections 5 and 6 of Lanark Township. Several other tracts are found along the Wisconsin River near the northern borders of the county. The total area is about 16 square miles.

Description.—The surface soil on this type to an average depth of 10 to 12 inches consists of a grayish-brown to brown fine sandy loam. There is only a moderate amount of organic matter in the surface soil which shows some acidity. The subsoil begins as a yellowish-brown fine sandy loam and changes at 20 to 24 inches to a brown compact gravelly clay loam. This compact stratum may extend to a depth greater than 36 inches or it may pass abruptly into stratified sand and gravel at 30 inches or below. This type, like all of the Antigo soils, is free from large stones and boulders, but a noticeable amount of gravel and cobbles is commonly found on the surface and in the subsoil. Ordinarily the soil is quite uniform in its characteristics, but some variation in the texture of the surface soil was noted. In the southeastern part of the county several tracts are finer in texture than typical, while in the vicinity of Benson's corners some of the type approaches a loam in texture. The boundary line between this type and Waukesha fine sandy loam is frequently an arbitrary one. As the latter type is approached the Antigo fine sandy loam gradually becomes darker in color. The portion of the type along the Wisconsin River has a chocolate brown color, contains considerable very

* For discussion of chemical composition and management of this soil see page 36.

fine sand, and a smaller amount of gravel than is found in the typical sand. The depth to sand or stratified sand and gravel is also less than in the typical soil.

Topography and drainage.—The surface is level to very gently undulating, sometimes having a very gentle slope toward the stream along which it occurs. It usually occupies a position well above all the flood plains, and because of the open character of the subsoil the natural drainage is excellent. Along the Wisconsin River the type is lower than elsewhere, and in a few instances the lowest portion has been flooded during extremely high water.

Origin.—This soil is of alluvial origin and occurs as stream terraces or outwash plains. It has been derived largely from crystalline rocks and carried to its present position through the action of running water.

Native vegetation.—The original timber growth consisted of pine and hardwood mixed. In some places the pine predominated, while in others the hardwood was the chief tree growth with hemlock also occurring to some extent.

Present agricultural development.—Antigo fine sandy loam is considered one of the most desirable soils in the county, though few farms are located entirely upon it. It is highly improved, and is well adapted to all of the general farm crops grown in the region. It is devoted chiefly to general farming and dairying, with potato growing an important branch of the farm practice. Due to the large amount of fine sand present in the surface soil it is easy to cultivate and can be kept in a good state of tilth under a wide range of moisture conditions. The surface features permit the use of all modern farm machinery.

The crops most extensively grown and the yields usually obtained are oats 35 to 60 bushels per acre, corn 40 to 65 bushels, silage 15 tons, hay 1½ to 2½ tons, barley 25 to 35 bushels, rye 20 bushels, and potatoes from 150 to 200 bushels per acre. Strawberries and bush berries for home use are grown, though the lack of good air drainage would doubtless make commercial orchards hazardous. Apple trees make a thrifty growth on the higher portions of this soil and a few well selected varieties could doubtless be successfully grown for home use.*

* For discussion of chemical composition and management of this soil see page 36.

WAUKESHA FINE SANDY LOAM

Extent and distribution.—The Waukesha fine sandy loam is of very limited extent, the largest tract occurring directly south of Arnott forming a part of Little Whig Prairie. The total area of the type is about 3 square miles.

Description.—The surface soil of this type to an average depth of 12–14 inches consists of a black or very dark brown fine sandy loam to loam, and contains a large amount of organic matter. The subsoil begins as a brown sandy loam which changes at 20–24 inches to a brown or yellowish brown compact gravelly sandy loam or gravelly clay loam. This compact layer usually extends to a depth greater than 3 feet, but it is underlain by a lighter colored stratified sand and gravel which may be encountered at or below 30 inches. There are no variations worthy of note except that the color of the soil grows lighter as the neighboring Antigo types are approached.

Topography and drainage.—The surface of this soil is level or very gently undulating. Although the downward movement of water through the soil is somewhat slow, the type in general is fairly well drained. After heavy rains, especially during the spring, water may stand on the lower places for a time. The soil retains moisture well, and crop yields are seldom diminished through lack of water.

Origin.—This soil is of alluvial origin and occurs as flat terraces along streams or as outwash plains. The dark color of the surface is due to the accumulation of decayed organic matter.

Native vegetation.—The original timber was oak, maple and some pine. Some of this land was never forested.

Present agricultural development.—This is a very good soil for general farming and all the land is improved and under cultivation. Dairying is extensively practiced, and hog raising is also an important source of income. Large yields of oats, rye, barley, clover, corn, and potatoes are obtained nearly every year. The soil is heavier to work than the sand soil, but owing to the large amount of organic matter present, a good tilth is readily secured. The strong acidity of the soil makes it highly desirable to apply lime in order to get the best results.

CHEMICAL COMPOSITION AND FERTILITY OF LOAMS AND FINE SANDY LOAMS

These soils are only a little more open in texture than the silt and clay loam types. They have a good water-holding capacity and will support very good pasture, but the somewhat higher percentage of fine sand which they contain reduces the water content of the surface somewhat so that they warm up more readily in the spring and have less tendency to bake and crack than the heavier soils. These qualities make them better adapted to such crops as corn and potatoes than are the heavier soils.

The total amount of the plant food elements, phosphorus and potassium, is nearly if not quite as large in the Kennan and Antigo fine sandy loams as in the silt loam. However, they have rather less organic matter and this, together with the somewhat coarser texture results in a slower rate of chemical change by which the inert plant food of the soil becomes available to crops. For this reason the increase in the supply of active or fresh organic matter and the use of available plant food either in the form of stable manure or of commercial fertilizers becomes more important and especially when crops such as potatoes which are sold from the farm, and of which heavy yields must be grown to be profitable, are produced.

The increase in the supply of active organic matter is of the utmost importance. A high degree of fertility cannot be maintained in these soils unless about twice as large an amount of organic matter is developed in them as that which they originally have. The plowing under of legumes, such as a second crop of clover or a crop of soybeans, is the best method of securing this result. The application of phosphorus and potassium fertilizers can best be made for these crops, since it secures a much larger growth of these crops themselves and becomes available through their decomposition to the following crops of corn or potatoes.

These soils wee derived from rocks devoid of lime carbonates and therefore have a marked tendency to become acid. The degree of acidity is usually only slight in the new soil, but increases as the land is cropped from year to year. This acidity does not affect the growth of most crops directly, but makes it more difficult to maintain a good degree of fertility. This is

true because it is a condition unfavorable to the continued growth of the best legumes—clover and alfalfa. The slight degree of acidity does not interfere with the growth of clover while the soil is comparatively new, but does reduce the yields as the fertility is reduced by further cropping and even in the virgin condition acidity interferes with the growth of alfalfa. It is also a condition unfavorable to the maintenance of a good supply of readily available phosphorus in the soil. These objections are probably not sufficient to make necessary the use of lime to correct the acidity on all of the land under cultivation for a number of years, but does make it desirable that farmers wishing to grow alfalfa should lime as well as inoculate the soil for this crop and also to watch the growth of clover carefully from year to year, so as to begin the use of lime on the fields as they are sown to clover as soon as it becomes difficult to secure a good stand.

These types of soils are well adapted to general farming and some special crops such as potatoes can also be grown to good advantage.

CHAPTER IV.

GROUP OF MEDIUM SANDY SOILS

COLOMA SANDY LOAM

Extent and distribution.—This soil with its shallow phase occupies 10.9 per cent of the county, the phase embracing less than one-tenth of the total area.

The typical soil is well distributed throughout the two eastern tiers of townships where it occurs in areas of from a few acres to several square miles.

Description.—The soil of the Coloma sandy loam to an average depth of 10 to 14 inches consists of a brown or grayish-brown, mellow sandy loam, with only a moderate content of organic matter. The subsoil is a buff-colored or yellowish-brown, light-textured sandy loam. It changes at 20 to 24 inches into a light-brown, compact, gravelly sandy loam or gravelly clay loam layer which has a thickness of 6 to 10 inches. Below this a gravelly sand extends to a depth of over 36 inches. Stones and bowlders occur in places upon the surface, but usually not in sufficient numbers to detract from the value of the type. Areas wherein stones and bowlders are so numerous that their removal presents a serious problem are indicated on the soil map by means of stone symbols.

A variation in texture occurs in this type, where the surface soil is a brown or light-brown loamy sand. This light-textured soil is confined chiefly to the region south and west of Amherst. Some eroded terraces are also included, the soil here differing from the typical chiefly in topography, although it also contains more gravel.

Topography and drainage.—The surface of the Coloma sandy loam varies from gently rolling to rolling and hilly. The roughest areas are those which are extremely stony. Because of the surface relief and the loose character of the material the natural

drainage is sometimes excessive and the type is somewhat droughty, though not as markedly so as the Coloma sand. An exception to this thorough drainage occurs in township 25, range 9, where several areas have rather imperfect drainage, even though the surface is somewhat rolling, owing to the impervious nature of the compact layer in the subsoil.

Origin.—The Coloma sandy loam consists of glacial material which was derived in part from sandstone and in part from crystalline rocks. Because of its sandy nature and high percentage of material from sandstone it has been classed with the Coloma series. All of the material forming the soil is in an acid condition.

Native vegetation.—The original timber growth consisted chiefly of oak, maple, and white pine, the best of which has been cut.

Present agricultural development.—The greater proportion of this soil is cleared and under cultivation. It may be considered as being moderately productive with all the advantages as well as some of the disadvantages of a sandy soil. The crops to which it is best adapted are potatoes, corn, rye and truck crops. Oats and hay can be produced, but the yields are not very heavy. The methods of farming are not those best suited to increasing the fertility of the soil. Stable manure is the only fertilizer used to any considerable extent and the supply of this is inadequate. Green manuring is seldom practiced.

This soil is better adapted to potatoes than the sand types, and wherever possible such soil should be selected for commercial potato growing in preference to sand.

While Coloma sand is somewhat deficient in plant food elements it is a fair soil and can be successfully improved.

For a more complete discussion of the chemical composition and management of this soil see page 44.

Coloma Sandy Loam—Shallow Phase.—This phase is confined entirely to the northwestern portion of the county chiefly in the towns Eau Plaine and Dewey. It covers a total area of 4,928 acres.

The surface soil is similar in color and texture to the typical soil but usually not quite as deep. The subsoil to a depth of about 2 feet is also about the same, though in the shallow phase it is sometimes slightly mottled. Below 2 feet the subsoil is usu-

ally a mottled sandy loam or sometimes a gritty clay loam. This rather heavy material usually extends below 36 inches, though frequently a layer of sand and gravel is encountered below 30 inches. In a few places the subsoil below 20 inches was found to be a heavy, greasy, gritty, dark red clay.

Angular granitic stones are scattered over the surface in places. A few rounded bowlders were also noted. Extremely stony areas are shown on the map by symbols.

The surface features are very similar to the typical soil, but the natural drainage is not quite as thorough.

In origin the phase differs more from the typical soil than in other respects. The surface may be partly glacial from an early glaciation which influenced this portion of the county only very slightly. The subsoil where heavy and containing angular rock fragments is doubtless residual from granitic rocks. The depth to rock usually being less than on the typical soil has suggested the term "shallow phase".

The original timber growth was the same as on the typical soil. The same crops are grown, about the same yields obtained, and the soil has practically the same value as has the typical soil, and for these reasons they have been placed in the same type.

PLAINFIELD SANDY LOAM

Extent and distribution.—The Plainfield sandy loam is one of the important and extensive types of soil in Portage County. The largest body of this soil is an irregularly broken belt extending through the center of the county from north to south. This tract is about seven miles long and extends from north of Ellis to a point several miles south of Stockton. Several smaller areas of one square mile or more are found in Alma and Buena Vista Townships and in the vicinity of Rosholt. It covers a total area of about 52 square miles.

Description.—The surface soil of this type to an average depth of from 8 to 12 inches consists of a grayish-brown or brown sandy loam, with a rather low content of organic matter. The subsoil is a yellowish-brown loamy sand to sandy loam in its upper portion, changing at 20 to 24 inches to a brown compact gravelly sandy loam or gravelly clay loam. This may continue to a depth of over 36 inches or change abruptly to a

coarse yellow sand intermixed with layers of well rounded granitic gravel.

The chief variation in the texture of this soil is where the type joins the Plainfield sand in which the surface soil is often a loamy sand or in a few places a sand. South of Ellis the surface soil is somewhat darker than typical, but the texture is still a sandy loam. The same condition occurs to a lesser extent in a number of places throughout the type. Small amounts of gravel are found upon the surface in places and also in the upper subsoil, but as a rule the gravelly material is concentrated in the lower subsoil, chiefly below a depth of 20 inches.

Topography and drainage.—The surface of this soil is level or very gently undulating. It is largely a terrace formation which is well above the present flood plain of the streams. These terraces may occur at different elevations with steep, abrupt slopes leading from one to the other. These slopes are often quite badly eroded and in some instances erosion channels have eaten their way back into the terrace for a short distance. Where erosion or other causes have left the terrace cut up so that it has lost its level characteristics, such tracts have been included with the Coloma sandy loam.

Because of the elevated position of some areas, and because of the character of the soil and subsoil in all cases the natural drainage of this type is good. Over the lowest portions of the soil spring rains may cause small pools of water to stand on the surface for a while, but seldom as long as to delay the usual spring work. The soil, however, is usually sufficiently heavy to retain moisture fairly well and general farm crops do not suffer to a much greater extent than on the heavier types of the county.

Origin.—The Plainfield sandy loam is a water-formed soil and occurs as level stream terraces or outwash plains. It is formed from both sandstone and crystalline rocks. Most of the gravel especially that in the subsoil is of these latter rocks.

Native vegetation.—The original stand of timber was white oak, red oak, maple, elm and some white pine. All of this has been cut except a few scattered wood lots.

Present agricultural development.—Practically all of this soil has been cleared and is at present under cultivation. It is considered a fairly fertile and productive soil, easy to work, and one which can be cultivated under a wide range of mois-

ture conditions. It is quite low in organic matter and in its water holding capacity and presents some problems common to all sandy soils. The leading crops grown are potatoes, corn, rye, and barley. Potatoes form the leading cash crop, and much of the land is devoted to the growing of potatoes. Soy beans have been successfully grown, and where the soil has been limed and manured good yields of alfalfa have been secured.

This is one of the most desirable extensive soils in the state for the commercial growing of potatoes. Having some silt and clay present in the subsoil it retains fertilizers and moisture much better than the sand types, and is easier to improve. While it is somewhat deficient in plant food, this defect can be corrected quite readily. For a more complete discussion of the chemical composition and management of this soil see page 44.

WAUKESHA SANDY LOAM

Extent and distribution.—The principal area of Waukesha sandy loam occurs in the vicinity of Almond where it forms an extension or part of the Grand Prairie which lies to the south in Waushara County. A smaller tract is found north of Arnot. The total area is 5,440 acres.

Description.—The surface soil is a sandy loam ranging in depth from 8 to 16 inches. It is dark brown to black in color when moist, and dark gray to dark grayish-brown when dry. This soil was originally a prairie and the dark color is due to the high content of organic matter. The surface soil is underlain to a depth of 18 to 24 inches by a brown sandy loam where it passes into a brown, compact, gravelly sandy loam, or gravelly clay loam. This compact stratum may extend to a greater depth than 36 inches, but it is usually underlain at a depth of 30 inches or over by sand and gravel. This sand and gravel is distinctly stratified and the change from the overlying material to it is almost always very sharp and abrupt. No important variations exist except that the line between the Waukesha sandy loam and the associated Plainfield types is usually somewhat indistinct.

Topography and Drainage.—The soil occurs as level outwash plains or as terraces in a succession of bench levels which vary in topography from level to very gently undulating. The natural drainage is excellent, and in places excessive water will some-

times stand for a time in low places in the spring or during continued rainy periods. The soil retains moisture fairly well, and crop yields are more certain than on the sand soils.

Origin.—This is a water laid soil and consists of stream terraces, outwash plains or filled in valleys. The dark surface soil is due to an accumulation of decayed organic matter, largely prairie grass.

Native vegetation.—Most of this soil was originally treeless and covered chiefly with prairie grass, however, there was a scattered tree growth about the margins of the prairie in a number of places. This consisted of red, black, and white oak and some white pine.

Present agricultural development.—Practically all of this soil is improved and under cultivation. Dairying is the leading industry followed with potato growing as an important branch of farming. The soil is easy to work and can be cultivated under a wide range of moisture conditions. It is one of the best corn soils in this county. Good yields of all common farm crops are produced, although the chief crops are corn, potatoes, rye and hay. The farms and buildings have a prosperous and well kept appearance, and the price of this kind of land is as high as of any land in the county.

While this soil is acid and needs lime, it can be readily improved. For a discussion of the chemical composition and management of Waukesha sandy loam see page 44.

BOONE SANDY LOAM

The Boone sandy loam covers only about 3 square miles and is confined to the country west and southwest of Stevens Point on the west side of the Wisconsin River, chiefly in Linwood Township.

The surface soil to a depth of 8 to 12 inches is a brown sandy loam underlain to about 20 to 24 inches by a light-textured, yellowish-brown sandy loam. The subsoil from 20 to 24 inches to over 36 inches is a yellow sand except where the Potsdam sandstone is reached, as is the case in a few instances. Slabs and fragments of this parent rock occur on the surface and through the soil profile, though usually not in great numbers.

This type varies from undulating to gently rolling. The surface drainage is fairly good, but the underlying sandstone

rock frequently comes to within 2 or 3 feet of the surface and this sometimes produces rather imperfect underdrainage. The overlying soil has the ability to absorb a large amount of water, but the sandstone is less pervious and the water will follow this rock stratum with a resultant springy condition over areas where the surface material is shallow or on slopes where the horizontal rock strata come close to the surface. In such localities the surface soil is usually somewhat darker than typical and the subsoil mottled more or less with drab, yellow and rusty brown.

The methods of farming and the crops grown on this type are practically the same as those for the Plainfield sandy loam. The Boone sandy loam, however, has a lower agricultural value.

CHEMICAL COMPOSITION AND FERTILITY OF MEDIUM SANDY SOILS

These soils have intermediate texture and hence have moderate water-holding capacity. They are not fine enough to be especially well adapted to grasses for pasture, though a fair quality of pasturage can be secured on the heavier phases of these soils. The more deeply rooted crops, such as clover, rye, corn, and potatoes, find sufficient moisture during average seasons and suffer from drought only during periods of relatively low rainfall.

In chemical composition these soils are also of an intermediate character. The total phosphorus averages from 850 to 900 pounds in the surface 8 inches per acre. The total potassium of the surface 8 inches per acre is 25,000 to 30,000 pounds or but little over one-half of that found in heavier soils such as the Kennan silt loam. The organic matter of these soils is also comparatively low, averaging from 2.5 to 3.0 per cent in the surface 8 inches and from 1 to 2 per cent in the second 8 inches. They have a correspondingly low nitrogen content, averaging from a thousand to 1,500 pounds in the surface 8 inches and from 500 to 800 pounds in the second 8 inches. As indicated by its dark color, the Waukesha sandy loam contains somewhat more nitrogen than the other types of the group, but this frequently quite resistant and not readily available.

The most important point in the management of all these soils is to follow methods which will maintain and increase the

organic matter. In the virgin condition these soils are but slightly acid as a rule, but with continued cropping the acidity increases and for the best growth of clover and especially alfalfa liming is essential. This use of lime not only makes the soil more suitable for the growth of alfalfa and clover but assists in preventing the leaching of phosphorus and maintaining it in a form which is available for growing crops.

The management of these soils to maintain the fertility will depend to a considerable extent on the crops grown and on whether or not stock is maintained to which the produce of the farm is fed. When dairying or other live stock farming is practiced it will be less difficult to maintain the supply of the essential elements of plant food—phosphorus, potassium, and nitrogen. But even when stock is maintained it is very probable that the moderate use of some form of phosphorus fertilizers will be found profitable, and some means for increasing the organic matter in addition to the use of stable manure should be made use of as far as practicable. The growth of a crop of soy beans or clover, occasionally, to be plowed under as a green manuring crop, will be found very profitable in its effect on the succeeding crop of corn or grain.

When these soils are used for the growing of potatoes or other special crops to a considerable extent the use of commercial fertilizers containing phosphorus and potassium will be found necessary to maintain the soil productivity. Clover or some other legume must be grown regularly in the rotation to maintain the nitrogen and organic matter, and part or all of this should be plowed under. It is often desirable to use the commercial fertilizers containing phosphorus and potassium in order to secure a good growth of this clover and there is little loss in so doing, since essentially all of the phosphorus and potassium applied to the soil for the clover becomes available to the succeeding crop through the decomposition of the organic matter.

The liming and also the inoculation of the soil is of the utmost importance when alfalfa is to be grown and will be found helpful on the older fields even for the growth of medium red or mammoth clover.

While the use of commercial fertilizers containing phosphorus and potassium is desirable in the management of these soils it must not be considered that this is an indication that they

have less value, than heavier soils which are relatively higher in these elements, for the growth of potatoes and other special crops. The fact that these soils become dry and warm early in the season makes them less subject to local frosts and the finer tilth which these sandy loams develop fit them especially well for the growth of potatoes and some other root crops, since they are practically free from checking and cracking. The cost of these fertilizers is a comparatively small part of the total cost of growing these crops. This group of soils is well adapted to the commercial growing of potatoes, and whenever possible the sandy loams should be seleted for this crop in preference to sand types. A good rotation for these sandy loam soils consists of small grain, clover and potatoes. For further suggestions on the management of these soils and for information regarding source and use of fertilizers consult Bulletins 204 and 230 of the Experiment Station.

CHAPTER V

GROUP OF SAND SOILS

PLAINFIELD SAND

Extent and distribution.—The Plainfield sand is one of the most extensive soil types in Portage County. The greater proportion is found in the central and southwestern portions of the county in the vicinity of and to the south of Bancroft, south of Plover, and about Arnott. One large tract is confined to the valley of the Wisconsin River, chiefly between the river and the Buena Vista marsh. Small patches are also scattered throughout the eastern portion of the county.

Description.—The surface soil of this type to an average depth of 10 inches consists of a brown or grayish-brown sand. The subsoil is a yellowish-brown sand which becomes coarser, lighter in color, and more gravelly with increased depth. Below about 24 inches the sand and gravel is very distinctly stratified and has a marked yellow tinge.

The soil as a whole is quite uniform, but a few slight variations occur. In small depressions there is more organic matter than usual, and this gives the material a slightly loamy appearance. In the southwestern part of the county there is a large proportion of quartz grains in the sand, while in the central part of the county the feldspathic materials from granitic rocks are more abundant.

The line drawn between this type and the Plainfield sandy loam is somewhat arbitrary. Usually as the sandy loam is approached the surface soil becomes somewhat more loamy, and in small slightly depressed areas there is a sticky layer in the subsoil at a depth of 20 to 24 inches. Small areas differing little in topography from the remainder of the type and situated well within its general development are frequently somewhat darker in the surface soil than typical.

Topography and drainage.—The surface of this soil is level or very slightly undulating. Because of the loose character of both the soil and subsoil the drainage is excessive except in places where the water table comes close to the surface or along the border of marshes. Crops suffer from lack of water over most of the type unless the rainfall is heavy and very regularly distributed.

Origin.—The Plainfield sand is of alluvial origin and has been formed by the water of the Wisconsin River or deposited as outwash plains by the streams of glacial times. Being assorted by running water, the finer soil grains were carried away, leaving the coarser sand grains deposited in horizontal layers. The parent material came both from sandstone and granitic rock formations. All of the soil is acid.

Native Vegetation.—The original timber growth consisted of scrub oak, red oak, some white oak, Jack pine, some white pine and sweet fern. The Jack pine was the most common.

Present agricultural development.—Most of this land has been cleared and placed under cultivation. This is due, no doubt, to the ease with which it can be cleared rather than to the fertility and productive qualities of the soil. Abandoned farms are not unusual, especially in the valley of the Wisconsin River, and fields sometimes remain idle for several seasons at a time. The chief crops grown at present are potatoes, corn, rye, oats and some hay. Soy beans have been grown both for forage and for seed with good results, though not on an extensive scale. Where difficulty has been experienced with clover, soy beans have been grown instead. Both are legumes, and the soy bean seems to be adapted to the conditions prevailing on the Plainfield sand. Potatoes and rye are the chief cash crops, the other crops being grown mainly to feed the dairy cow. The yields of all crops are considerably less than the yields produced on the heavier soils of the county. The difficulty in maintaining good pasture and in growing sufficient hay for feed prevent the development of the dairy industry to such proportions as on the heavy soils.

While potatoes are grown quite extensively, the Plainfield sand is not as well adapted to this crop as are the sandy loam soils. Corn will show greater increase in yields as this soil is improved than will potatoes, and corn should therefore be grown more extensively than potatoes.

VIEW SHOWING TYPICAL LEVEL SURFACE OF PLAINFIELD SAND—RYE IS AN IMPORTANT CROP ON THIS SOIL

Because of the rather coarse texture of this soil, and the loose, open character of the subsoil, it requires very careful management. There are over 78,000 acres of Plainfield sand in this area.

CLOVER ON PLAINFIELD SAND

This is a second cutting of clover that is being saved for seed. With careful management and proper fertilization good crops of clover can often be secured, and when a soil can be made to produce good clover its permanent improvement is well under way. A good rotation for such soil is rye, clover and corn.

Plainfield sand is deficient in the plant food elements and its successful cultivation requires special care. A more complete discussion of the chemical composition and management of this type will be found on page 54.

COLOMA SAND

Extent and distribution.—The Coloma sand is confined to the eastern half of the county where it is associated with other types of the Coloma series. It occurs in numerous small tracts instead of extensive, continuous areas. This type covers a total area of about 118 square miles.

Description.—The surface soil of this type to a depth of 6 to 10 inches consists of a brown or grayish, rather loose sand of medium texture, which in local areas approaches a fine sand. Over some areas of virgin soil the surface 1 or 2 inches is somewhat darker than usual owing to a small accumulation of organic matter which usually disappears after being cultivated for a few years.

The subsoil consists of a yellowish-brown or light brown sand of medium texture which usually becomes lighter in color and coarser in texture with increasing depth. A small amount of gravel may be found in the surface portion of the type, but such material occurs with greater prominence below a depth of 24 inches.

The number of stones and bowlders present is variable and in some localities they are sufficiently numerous to justify a separation on this basis. Wherever the stones and bowlders were found to be sufficiently abundant to interfere with agricultural operations such areas were indicated separately on the soil map by appropriate symbols. Where this stony, bowldery condition prevails, there is often more variation in the texture of the soil material than over the typical portion of the type. The surface over limited areas may be a sandy loam, and in the subsoil a compact sandy loam stratum about 6 inches in thickness may occur at a depth of 18 to 24 inches. Such variations, however, were only very small and could not be shown separately.

Topography and drainage.—The surface of the typical soil varies from undulating to gently rolling. There has been included some rather steep slopes where there is a drop from one terrace to another. While this class of land is not typical for

Coloma sand it has been included because of its limited extent and because it has about the same agricultural value. The portion of the type indicated as covered with stones and bowlders is rougher than the typical and includes the roughest land in the county. The surface varies from rolling to hilly and broken with only a few small tracts that are of the same topography as the typical soil.

Because of the loose open character of the material and the surface features, the natural drainage is excessive and the soil is droughty. Highest yields are received during years of most abundant rainfall.

Origin.—Coloma sand is a glacial soil derived largely from sandstone but in part from granitic rocks, by the action of the ice sheets. The sand grains consist chiefly of particles of quartz with a mixture of varying amounts of material from dark colored rocks. The stones on this soil are not of sandstone but have been brought in from the north by the glaciers. Practically all of the soil material is acid.

Native vegetation.—The original timber growth was very thin and of poor growth, consisting of Jack pine and scrub oak.

Present agricultural development.—Probably the greater proportion of the typical soil is cleared and under cultivation, but most of the stony part is still in timber and used for pasture. Land of this type is of a lower value than most of the other classes of land in the county due to its sandy nature and low fertility.

The type of agriculture most extensively followed consists of general farming with potato growing given most prominence. Dairying is practiced to a smaller extent than on the heavier soils of the area. The chief crops grown and average yields obtained are potatoes 75–125 bushels per acre, rye 8–15 bushels, oats 15–25 bushels, corn 15–30 bushels, hay ½ to 1 ton and buckwheat 12–18 bushels. Much depends upon the amount and distribution of rainfall, the manure applied or legumes plowed under. The type is easily run down by continuous or improper cropping. The soil is easy to cultivate but the methods which are followed are usually not those best suited to building up the fertility.

The yields of corn can be more readily increased on this soil than can the yields of potatoes, and for this reason more corn

and less potatoes should be grown. Potatoes are better adapted to the sandy loam soils.

For a full discussion of the chemical composition and management of this soil see page 54.

Coloma sand—shallow phase.—This phase covers a total area of only 5,440 acres and is confined to the northwestern part of the county in Townships 24 and 25 N., Ranges 6, 7 and 8 E. It occurs as patches, knolls and stripes of upland, often bordering streams or lying in the vicinity of marshes. The largest single area is on elevated, undulating to rolling bluffs or knolls in the vicinity of the Wisconsin River to the east and northeast of Junction City.

The shallow phase is quite similar to the typical soil in the surface and upper subsoil. In the lower subsoil, however, coarse angular rock fragments occur in places and frequently there is sufficient clay to make the material slightly sticky when wet. This deep subsoil is also varied in color and often rests upon granitic rocks at depth of about 3 feet, while the typical soil usually extends to a much greater depth.

On areas of this type along Mill Creek in T. 24, R. 6 E., occasional granitic bowlders may be found lying on low knolls or slopes of deep sandy soil. On the large area 3 miles north of Junction City and the areas east and northeast of Junction City in the vicinity of the Wisconsin River the soil is thickly covered in places with angular blocks and fragments of granitic rocks. In Section 9, T. 24, R 7, E., these fragments and blocks also occur in the subsoil and grade into the underlying rock. In some instances a few rounded granitic bowlders are found, especially on areas near the Wisconsin River.

In topography and drainage conditions the phase corresponds closely with the typical soil.

In origin the lower subsoil is largely residual while the surface may be partly residual and partly glacial from material deposited by one of the early ice sheets.

In agricultural value, present crop yields and systems of farming followed there, is practically no difference between the shallow phase and the typical soil.

WAUKESHA SAND

Extent and distribution.—Waukesha sand is an important type from the standpoint of the area which it covers. It is confined largely to the valleys of the Wisconsin and Plover Rivers. The largest body begins at Plover and extends north about 15 miles up the Plover River. Along the Wisconsin River it occurs mostly on the east side. It covers a total area of about 34 square miles.

Description.—The surface soil of this type to an average depth of 6 to 8 inches consists of a dark brown or dark gray sand or loamy sand which appears nearly black when moist. The content of organic matter is greater than in the Plainfield sands with which it is associated.

The subsoil begins as a brown or light brown, loose, open sand which becomes lighter in color and somewhat coarser in texture with increasing depth. A limited but variable percentage of small rounded gravel is commonly found in the subsoil at and below a depth of 20 to 30 inches. The deep subsoil is stratified, thin beds of fine and medium sand alternating with coarser textured material. Both soil and subsoil show varying degrees of acidity. The surface is stone free.

While the type as a whole is quite uniform, there are a few minor variations worthy of note. In Section 5, T. 24, R. 8 E., the surface soil is somewhat coarser than typical and contains a small amount of angular gravel. West of Jordan the surface is slightly undulating and the soil is variable in color within short distances. The irregularities of the surface appear to be due to wind action and the higher places are usually lighter colored in the surface soil than the depressions.

Topography and drainage.—The surface of this soil type is for the most part level with only a few knolls which have been caused by the wind. Because of the loose, sandy nature of the soil, crops suffer from lack of moisture during some part of every season.

Origin.—This soil has been formed by water action and consists of stream terraces, outwash plains, or filled in valleys. The characteristic feature and the one which distinguishes this from the Plainfield sand is the dark surface soil and the resulting higher content of organic matter.

Native vegetation.—A portion of this soil was originally without trees and is spoken of as prairie. The growth and decay of grasses gave the soil its dark color. Over smaller tracts and on the border of the larger areas, white pine was found. All of this has been cut, and the land now has the appearance of a sandy prairie.

Present agricultural development.—While this soil is not as extensive as some other types in the county, it is especially well located and for this reason is of greater importance agriculturally than if distinctly removed from cities or transportation facilities. The greater proportion of this soil has been cleared and placed under cultivation, but because of low yields, fields are frequently abandoned or allowed to remain idle for several years at a time.

The chief crops grown are potatoes, corn, rye, oats, buckwheat and hay. General farming is the leading type of agriculture followed, but dairying and hog raising are not nearly as extensively developed as in regions of heavier soils in this and adjoining counties.

Average yields of all general farm crops grown are small. During seasons of abundant or well distributed rainfall, fair to good yields may be secured. Near Stevens Point some trucking is carried on and where the soil is given the best of management profitable returns are secured. The soil does not wear well, however, and frequent fertilization is necessary in order that pofitable yields may be secured from year to year.

Because of its loose open structure, this soil is easy to cultivate. Difficulty is experienced in getting clover started, chiefly because the soil is acid and partly because of its low fertility and droughty condition. Practically the only fertilizer used is stable manure, some of which is secured in Stevens Point. But little stock is kept on the average sand farm.

While potatoes are doubtless the most important crop grown at present, this soil is not especially well adapted to potatoes. It has been found by test that the yields of corn can be much more readily increased on this kind of soil than can the yields of potatoes. The acreage of corn could well be extended and silage used for summer feeding of stock. This would permit a reduction of the acreage devoted to pasture, which would be desirable, since such soil does not produce good pasture.

CHEMICAL COMPOSITION AND FERTILITY OF SAND SOILS

In some respects sandy soils have advantages over heavier soils. They become drier and therefore warmer and can be worked earlier in the spring and more quickly after rains than heavier soils. These advantages are particularly important in regions of short growing periods. But when the soil is too sandy it does not hold sufficient water from one rainfall to another to satisfy the needs of the growing crops and they therefore suffer from drought. Moreover, some sandy soils are lower in their supply of the chemical elements demanded by crops than heaver soils. When these two factors become too low they limit the profitable farming of these soils. In the mapping of the Soil Survey those soils which are classed as fine sands or sandy loams have fairly good water-holding capacity, and when their fertility is properly maintained their good qualities in regard to warmth and earliness can be taken advantage of and they can be farmed with profit. But soils which are classified as sands, such as the Coloma and Plainfield sands, are so coarse as a rule that they do not have sufficient water-holding capacity and their use for the growth of staple crops is ordinarily unprofitable, unless unusual skill is used in their management. It must be kept distinctly in mind, however, that all types as mapped show some variation in texture or fineness of grain. The chief factor limiting their agricultural use is that of water-holding capacity. This depends chiefly on the texture or fineness of grain and cannot be affected by any treatment it is practicable to give them. The water-holding capacity can be somewhat increased by increasing the amount of organic matter, but this is a comparatively slow process and the amount of organic matter it is practicable to develop and maintain in these soils will increase their water-holding capacity only to a limited extent.

The total content of the essential elements of plant food in these soils is moderate. The total phosphorus in the surface 8 inches per acre averages between 750 and 900 pounds and in the second 8 inches between 600 and 700 pounds. The total potassium i nthe surface 8 inches per acre is 25,000 to 30,000 pounds in comparison with 50,000 or 55,000 pounds in the silt loam soils of that region. The total nitrogen content is between 1,200 and 1,400 pounds in the surface 8 inches per acre. The

Waukesha sand, as its dark color indicates, contains slightly more nitrogen than the other soils in this group.

When a sufficient supply of active organic matter is developed in these soils a considerable portion of the phosphorus and potassium will undoubtedly be made available, but the use of fertilizers containing these elements in a more readily available form is desirable whenever these soils are farmed.

The starting point in the improvement of these soils is the development of active organic matter through the growth of legumes which are able to secure their nitrogen supply from the atmosphere. But before legumes can be grown with the greatest success the liming of the soil is necessary. The growth of a good crop of mammoth clover or soybeans through the use of lime and mineral fertilizers coitaining phosphorus and potassium is the best means of supplying this nitrogen and organic matter. In most cases this legume should be plowed under as a green manuring crop.

Probably the best way to get clover started is to seed with a small grain. By using a light seeding of rye, disked or harrowed in and seeded to clover in the spring, a good stand can usually be secured. The seed should be put in a little deeper than on heavy soils, and the drill should be followed by a corrugated roller, or if this implement is not at hand, and ordinary roller, followed by a light harrow should be used. When clover is seeded with a small grain in this way the growing grain helps to hold the soil in place and prevent blowing of the loose soil by the wind.

As the result of careful experiments on extremely sandy soils it appears that the best crop rotation for this class of land consists of rye, clover, and corn. If the fertility is extremely low, it will be advisable to plow under the entire clover crop. If the fertility is fair the first crop may be cut for hay and the second plowed under. While potatoes are quite extensively grown on these extremely sandy soils this crop is not as well adapted to the sand soils as to sandy loam types. It has been shown by actual field tests that the yields of corn, for example, can be more readily increased on the sand soil than can the yield of potatoes. The potato when grown on sand soil does not respond to methods of soil improvement as readily as when grown on soils which contain somewhat more silt and clay. The sandy

loams and fine sands and fine sandy loams are much better adapted to potato culture than are the sand soils. It is therefore advisable to reduce, where possible, the acreage of potatoes on sand soils.

With an increased acreage of corn it will be possible to put up enough silage so silage may be used for summer feeding. With this practice less pasture will be required, and this again will be desirable since the sand soils do not supply good grazing, and are not well adapted to any of the grasses. This system would make possible keeping more stock, and with the increased supply of manure the fertility of the land could be more readily maintained.

CHAPTER VI.

GROUP OF POORLY DRAINED SOILS.

PEAT

Extent and distribution.—From the standpoint of area covered, Peat is the most extensive soil type of the county. By far the largest tract is found in the southwestern portion of the county. This is known as the Buena Vista Marsh and covers a total area of over two townships. Another extensive marsh area is found in the northwestern part of the county, chiefly in Eau PlaineTownship, and is a part of the Dancy Drainage District. This marsh extends for over 10 miles along Little Eau Plaine River, but only a small proportion of it is within the area surveyed. A considerable proportion of this marsh consists of peat. Another peat marsh is found immediately east from Jordan, and extending north from Stockton for over 6 miles. It has a width of about one mile. Numerous other small peat marshes occur through the northern and eastern portions of the survey.

Description.—The material mapped as Peat consists of decaying vegetable matter in varying stages of decomposition with which there has been incorporated a small amount of mineral matter. When raw and fibrous, and only slightly decomposed, the Peat has a brown color, but when more completely decayed it becomes darker and is sometimes black. It is light in weight as compared with other soils, and is loose and rather spongy. The surface material is often of a lighter brown color than that found at a depth of 2 feet or over. This is usually true of the timbered marshes in the region of glacial soils. In some instances the more thoroughly decomposed material occurs at the surface and raw fibrous peat is found at lower depths. This appears to be the case most frequently where marshes were originally treeless.

The material mapped as Peat ranges in depth from 18 inches to over three feet. Where less than 18 inches it has been classed as shallow peat and mapped separately. Probably about 1/3 of the deep peat has a depth of over 3 feet. In some instances the peat is known to be over 10 feet in depth. The material found beneath the peat usually consists of gray or nearly white sand of medium texture. In the northwestern part of the county where some of the upland soils are heavy, the underlying material is sometimes a clay loam or sandy clay. This is also true of some of the marshes in the eastern half of the county, especially in the northeastern section, where some of the marshes are surrounded by heavy soils. Where the marshes are surrounded by sandy soils the peat is usually underlain by sand, and where the upland bordering the marsh is heavy the material under the marsh is usually heavy also.

Topography and drainage.—The surface of all Peat areas is low, level, water soaked, and naturally very poorly drained and before farming the Peat must be reclaimed by some drainage system. A large proportion is included within drainage districts and has been drained more or less thoroughly by large open ditches which in some cases have been supplemented by tile drains.

Probably the most important factor determining the value of marsh land will be the crops which can be grown on it. This depends on two factors, first the degree of drainage, and second the danger from frost. When only the main outlet and lateral ditches have been installed, in the great majority of cases, hay crops are the only ones which can be safely grown, and the character of the hay will also depend a good deal on the character of the drainage. In the case of peat land underlaid by sand, the drainage by well constructed and sufficiently deep ditches 40 to 80 rods apart will, in most cases, give adequate drainage for hay. When the peat soil is underlaid by silt or clay, however, ditches not more than 20 rods apart will be necessary and these must lower the water in the ditch to a point four to five feet below the surface during part of the growing period. When tilled crops, such as corn, cabbage, or potatoes, or small grains are to be grown, the drainage must be more certain, and over the greater portion of our marsh lands this will mean the installation of dainage systems in the form of

VIEW OF DRAINED PEAT LAND IN BUENA VISTA DRAINAGE DISTRICT

There are over 85,000 acres of peat in Portage County. This is one of the largest drainage projects ever undertaken in Wisconsin.

SMALL GRAIN ON DRAINED PEAT LAND

When drainage is well established, and the proper fertilizers are used, general farming operations can be successfully conducted on peat land of this kind.

either open lateral ditches or of tile not more than ten and often not more than five rods apart on the average. Tile drainage is the more satisfactory. The cost of tile drainage will vary from twenty to thirty dollars per acre after the main outlets have been put in.

Frosts on marsh land.—It is well known that frosts frequently occur on marsh land where there is no frost on higher land. This is partly because the cold air which forms on the surface of all the ground at night tends to flow down and collect in low places, but it is also the result of the fact that the loose, spongy soil of peat marshes does not conduct the heat received from the sun during the day downward. In consequence of this, the lower layers of soil do not become warmed in peat marshes as they do in other earthy soils and the little heat left in the surface inch or two of soil is rapidly lost at night by radiation, so that the freezing point is frequently reached on such soil when it would not be on more earthy soils such as sandy loam or clay loam which would conduct the heat downward better during the day and so keep warm farther into the night.

This difficulty with peat marshes can be overcome to a certain extent by heavy rolling which, by compacting the soil, permits the heat to be conducted downward more readily. It will also to a certain extent become less in time, as the peat decomposes and takes on more of the character of muck. Nevertheless, it must always be expected that marsh land will be more subject to late Spring frosts and early Fall frosts than high land. It may be stated as a general guide, that the occurrence of killing frosts is as liable on marsh land at any given point as it is on upland soil having good air drainage about 150 miles farther north; in other words, the marshes of Dane County are as liable to have a frost which will kill corn as early as are the upland regions of Shawano, Marathon, or Clark Counties. The marsh land regions of Portage County are liable to have frost two weeks or more earlier than the hill tops of the same latitude. This means that corn and potatoes, while safe crops for the upland region, are not safe crops for the marsh land and should not be depended on as the chief crops.

Native vegetation.—The original vegetation on the Peat marshes consisted chiefly of coarse marsh grasses, sedges and sphagnum moss on the open marshes, with willow, alder, some poplar and tamarack on the timbered tracts.

Present agricultural development.—By far the most extensive farming operations on marsh land in this county are carried on in the Buena Vista Drainage District, in the southwestern portion of the area. Approximately one-half of this marsh consists of peat, and a considerable proportion of this has been placed under cultivation. Many substantial farm buildings have been constructed here, and farming is carried on with varying degrees of success.

The chief crops grown at present are corn, oats, rye, millet, buckwheat, timothy and alsike clover, potatoes and various root crops. Where proper methods of fertilization and cultivation are followed and where the drainage is sufficient, the yields are equal to those obtained on good upland soil. In many cases, however, the necessity of using fertilizers has not been realized, and the cultural requirements have not been fully met by most of the farmers. For these reasons, and owing to the fact that in some places the drainage has not been sufficient, crop yields have often been low, and some farmers have become discouraged. Where the drainage is not sufficient for growing cultivated crops, some marsh hay is frequently cut.

In the Dancy Drainage District some development has taken place on peat land also, but only a very small proportion of this district has been improved. Drainage projects are being considered for other peat marshes in the county, and in some cases small tracts are being reclaimed by individual effort.

Peat, shallow phase.—Shallow Peat is not nearly as extensive as is the deep peat. The largest tract is in the southwestern part of the county in the Buena Vista marsh where it is closely associated with the deep peat. It usually occurs as a gradation from deep peat on one hand to the black, wet Dunning soils on the other, and the variations in the type will range between these two conditions. Besides that which is found in the Buena Vista marsh, other areas are found in the northwestern part of the county, but these are small in extent.

The material mapped under this name consists of brown to black vegetable matter in varying stages of decomposition, with which there is incorporated varying amounts of mineral matter. The type includes those areas of peat where the depth of the accumulation will average about 18 inches though it varies from about 10 or 12 inches to as deep as 22 or 24 inches in a

few instances over small areas. The peat usually rests upon a gray to white sand of medium to fine texture, though in a few instances a clay loam or sandy clay was found. This heavy material usually occurs in the northwestern part of the county where there is considerable heavy soil in the uplands adjoining the marshes.

Little development has taken place on the shallow peat outside of that of the Buena Vista marsh where the peat has been drained and improved along with the deep peat.

CHEMICAL COMPOSITION AND FERTILITY OF PEAT

The chief difference between peat soils and upland soils consisting largely of earthy matter, is that they have relatively small amounts of the mineral elements phosphorus, potassium, calcium, and magnesium, and have extremely high amounts of nitrogen in the organic matter. The average per cent of phosphorus in the peats of this region so far analyzed is 0.135 per cent. This means that in an acre of soil to a depth of a foot there is approximately only 675 pounds, or in two feet 1,350 pounds in comparison with upland soils which have approximately twice these amounts. Moreover, the acid condition of these soils renders the phosphorus less available than in non-acid soil.

The deficiency of potassium in these soils is greater than that of phosphorus. They contain on the average 0.3 per cent of this element, while good upland clay loam soils average two per cent, or over six times as much expressed in percentage. When the greater weight of the upland soils is taken into account it will be found that they contain in the upper two feet 120,000 pounds per acre, while the peat soils contain but 3,000 pounds.

A large amount of organic matter in these soils gives them an extraordinary amount of nitrogen. They average 2.5 per cent of this element, while the upland silt loam soils of this region contain but about 0.12 per cent and this only in the surface eight inches—the amount in deeper layers being much less.

As a result of this difference in the chemical composition the peat soils are very unbalanced. Their rational treatment requires the use of fertilizers containing especially the elements phosphorus and potassium. These elements are contained in relatively small amounts in barnyard manure and good appli-

cations of manure will secure good yields of crops on peat soils, but manure contains large amounts of nitrogen not needed by the peat, so that when a farm includes upland soils as well as peat, the manure should be used on the upland soils and commercial fertilizers containing phosphorus and potassium used on the peat land.

On the deeper peats which are in a very raw and acid condition the use of lime in some form in addition to the commercial fertilizers will be found profitable. Occasionally a marsh is found on which on account of coldness and high acidity at first nitrification or the chemical change by which the nitrogen in the organic matter becomes available to crops does not take place readily and the use of a light application of composted stable manure to inoculate the soil with the proper organisms is very helpful.

Crops and system of farming on marsh lands.—Since the growth of corn and potatoes to which these marsh lands would otherwise be well adapted, is limited in this section on account of the danger from frost, the best staple crops for this land are grasses for hay and pasture, hardy root crops, and rye, and to a less extent oats. When properly fertilized and limed, clover, alfalfa, and other legumes can also be grown. On fairly well drained marsh land not too raw good pasture can also be developed. The compacting of the soil resulting from the use of this land as pasture is also a great benefit to it. When peat land is placed under cultivation a heavy roller should be classed along with implements necessary to its successful management.

On account of the crops to which this land is adapted and its use as a pasture, marsh lands can be used for dairying or stock raising to good advantage.

Certain special crops, such as cabbage, onions, buckwheat, and rape, are well adapted to such lands when well drained and fertilized.*

DUNNING SAND

Extent and distribution.—The Dunning sand is confined largely to the southwestern part of the county, where it occurs chiefly as a marsh-border type. It is encountered bordering

* For more complete discussion of the management of marsh soils see bulletin on this subject by the Agricultural Experiment Station.

areas of peat, in shallow depressions or basin-like areas in association with the Plainfield soils, and along stream courses throughout the region where sandy soils predominate. The largest tract occurs several miles west of Coddington. The type covers a total area of about 34 square miles.

Description.—Dunning sand to an average depth of 6 to 12 inches consists of a dark-gray to almost black sand rather high in organic matter. The subsoil to over 36 inches is a dull-gray or mottled gray and yellow sand, with more or less fine, well worn gravel in the lower part. In a few places the soil is loamy in texture.

The chief variation from typical occurs in the Buena Vista Drainage district, in an irregular area which originally consisted of shallow peat overlying sand. The shallow covering of peaty material has been burned off over this area, and the resultant soil consists of Dunning sand streaked and spotted with areas over which the surface soil from 2 to 10 inches consists of a gray, yellowish-brown or dark-gray ash mixed with sand. Here and there occur remnants of shallow peat which were not destroyed by the fire. These usually stand a few inches above the level of the surrounding soil.

Topography and drainage.—The surface of the Dunning sand is level and the natural drainage is deficient. Much of the type lies within drainage districts, where the drainage conditions have been greatly improved by the construction of large open ditches. In some places these have been supplemented by tile drains.

Origin.—This type is found mostly within the valley of the Wisconsin River and is largely of alluvial origin. As it occurs within or bordering marshy districts the moist conditions have favored the growth and decay of considerable vegetable mattre which accounts for the dark color of the soil. No calcareous material is present and both soil and subsoil are acid.

Native vegetation.—The original vegetation consisted of willow, spruce, and poplar, with some jack pine in the higher places and coarse marsh grasses in open stretches.

Present agricultural development.—Because of its generally rather poor drainage this type is not of much agricultural importance. Only a comparatively small proportion of it is under cultivation.

The chief crops grown on this soil are oats, corn, potatoes and hay. Buckwheat, alsike clover, millet, and rye are sometimes grown. This soil is considered to have a low value as it is deficient in potash and phosphorus and occupies such a low position that it must all be drained by open ditches or tile drains. In some cases the outlet ditches already installed do not appear to be deep enough to permit thorough drainage.

DUNNING SANDY LOAM

Extent and distribution.—The Dunning sandy loam covers a total of about 25 square miles, but occurs in rather small scattered areas, associated chiefly with the Colby, Plainfield, and Waukesha soils. The largest single area is found in the Town of Hull and the major portion of the type is confined to the northwestern quarter of the county.

Description.—The surface of the Dunning sandy loam extending to an average depth of 10 inches, consists of a dark-brown or black sandy loam or heavy sandy loam, high in organic matter. The subsoil usually consists of a yellow or gray sand, sticky sand or sandy clay loam. It is frequently mottled. The lower subsoil is subject to considerable variation, ranging from rather heavy sandy loam to beds of quite sandy soil. Thin lenses of clay loam may also occur, and gravelly material is frequently encountered in the subsoil.

Topography and drainage.—The surface of this type is level. It is low-lying and naturally poorly drained. Open ditches already installed provide fair drainage for part of the type, and supply outlets into which tile drains may lead, but most of this soil is still in an undrained condition.

Origin.—The type occurs as first bottom lands along stream courses, as low land bordering marshes, or as slight depressions in the uplands or in terraces. As found in this county the major portion of it is of alluvial origin. The parent material came in part from crystalline rocks, but probably the major portion was derived from sandstone. There is no calcareous material present and both soil and subsoil are acid. The growth and decay of vegetation accounts for the dark color and rather high organic matter content.

Native vegetation.—The native vegetation consisted mainly of alder, poplar, with some red oak and white pine on the better

drained areas. Coarse marsh grasses also grew upon this soil.

Present agricultural development.—Because of the rather limited extent, small scattered areas, and poor drainage conditions, the type is at present of little agricultural importance. Only a small proportion of this soil is under the plow. The chief crops are hay, small grains, corn and buckwheat. The soil, when thoroughly drained, is easily cultivated and may be considered a fairly productive soil, upon which satisfactory yields can usually be secured under good management when the season is not excessively wet.

This type has a larger supply of the mineral plant food elements than are found in peat, and it is a better balanced soil than the peat lands.

WHITMAN SILT LOAM

Extent and distribution.—This type is confined chiefly to the northwestern quarter of the county where the upland soils consist largely of the Marathon and Colby series. The type also occurs to a limited extent where the upland soil is of the Boone series, but in such localities the deep subsoil is usually of a sandy nature. Where the upland soils consist of the Kennan types, small areas of Whitman silt loam may also be found. For the most part this type occurs as narrow belts along stream courses, and but few of the areas contain more than one-quarter of a square mile. The type has a total area of about 8 square miles.

Description.—The surface soil of this type to an average depth of about 12 inches consists of a dark brown or black silt loam containing a high percentage of organic matter. The subsoil consists of a heavy silt loam or silty clay loam which usually extends to a depth of 36 inches or more, and frequently becomes somewhat heavier as the depth increases. The color of this subsoil material is usually a dark gray or drab which is frequently mottled with brown or yellow or sometimes both. In the deep subsoil some fine sandy loam is frequently found, and coarser material may occur, giving the subsoil a somewhat gritty character. In a few instances beds of fine sand were found at a depth of 30 to 36 inches.

The soil as a whole is rather uniform in its color and in the

texture of the surface soil, but as indicated the subsoil may be subject to considerable variation.

Topography and drainage.—The surface of this soil is level or very gently sloping, and because of its low position and the fact that some of it is subject to overflow, the natural drainage is poor.

Origin.—The Whitman silt loam has probably been derived from several sources. It is partly of residual, partly of alluvial and partly of glacial origin. It occurs as first bottom land along streams or in depressions in the upland where there has been an accumulation of organic matter due to the wet conditions existing.

Native vegetation.—The orginal stand of timber consisted of elm, ash, alder, and other water-loving trees and grasses.

Present agricultural development.—Because of its limited extent and its poorly drained condition, this type is at present of very little importance agriculturally. Only a very small part is improved and under cultivation. Where there is sufficient fall so that drainage can be accomplished, it can be farmed with profit. The soil is naturally very productive and well adapted to all the general farm crops grown in this section. It is well supplied with all of the essential plant food elements.

GENESEE FINE SANDY LOAM

The surface soil to a depth of 16–18 inches is a brown fine sandy loam to sandy loam. The 4 to 6 inches of the immediate surface are usually darker brown than the underlying portion. The subsoil begins abruptly as a yellowish fine sand stratified in the lower portion with layers of water worn gravel. This type occurs as low terraces along the Wisconsin River usually somewhat higher than the Genesee silt loam, but subject to periodic overflow. The topography is flat to slightly undulating interrupted frequently by abandoned stream channels or sloughs. These sloughs are filled with deep peat or hold water after the subsidence of the overflows. The drainage of the type is good between inundations.

The type is of limited extent and minor importance. Most of the type is still timbered to oak, elm, basswood, maple and white pine. Where cleared and cultivated the chief crops are

rye, corn, oats, hay and potatoes. Farming on this soil is uncertain because of danger of flooding. Reports indicate that floods occur every 3–5 years sufficient to destroy all crops with less destructive floods more frequently. The small extent of this type would not justify the construction of dikes to protect the land from flooding.

GENESEE SILT LOAM

The Genesee silt loam is of very limited extent and is confined entirely to the valley of the Wisconsin River.

The surface soil to a depth of 16 to 18 inches consists of a dark brown or reddish brown silt loam. A few inches of reddish brown sandy loam may intervene between the surface soil and the underlying loose, yellow sand and gravel, but in most places the change from heavy soil to sand is abrupt. The subsoil is distinctly stratified.

The surface is flat to slightly undulating except for abandoned stream channels or sloughs. The sloughs are either filled with a deposit of peat or else hold water after the subsidence of the overflow. The drainage is good except at times of high water when the land is flooded.

This is an alluvial soil and occurs as first bottom land along the Wisconsin River, and is subject to overflow.

This soil is nearly all timbered with soft maple, elm, ash, birch, and some basswood and oak.

A few spots have been cleared, and such crops as oats, corn, hay and potatoes are grown. The danger from flooding makes farming uncertain so that the development of this land is not encouraging. To prevent flooding, dikes would be necessary, and such a great expense would not be justified under present conditions.

CHAPTER VII

GENERAL AGRICULTURE OF PORTAGE COUNTY

The development of agriculture in this region was preceded by the growth of the logging and lumbering industry. The earliest settlements, about 1840, were made in the areas of sandy land, as the forest growth here was largely pine, which was the only timber handled by the early lumbermen. Hardwood at that time had but little value, and where early clearings were made in hardwood areas the timber was frequently burned.

The first farms opened after the advance of the lumbermen were small, and often large areas of land remained in the cut-over stage for a considerable time before being parceled out in small tracts. While farming ventures were first begun chiefly on the sandier soils, following the cutting of the pine, the highest agricultural development has been reached in those sections where the soils are heavier than those immediately along the Wisconsin River. Farming has extended to all parts of the county, and on the whole it is well improved agriculturally. The sections of least development are in the north-central and northeastern parts of the county and in those regions where marshy conditions prevail over large areas.

While practically all the general-farming crops now grown were produced in the early history of the county, the relative importance of a number of the crops has changed to a considerable degree. In 1879 wheat occupied 21,853 acres, more than twice the acreage in oats. By 1909 the total area devoted to oats had increased to 37,838 acres, while only 397 acres were devoted to wheat. The acreage to hay, corn, and rye has steadily incresed since the early history of the county. The development of the potato-growing industry has been very marked. In 1879 there was a total production of 213,570 bushels, while in 1909 the crop amounted to slightly over 2,500,000 bushels.

The agriculture of Portage County at present consists chiefly

of general or mixed farming, with dairying and potato growing as the two most important branches. The chief crops grown, in order of acreage, according to the 1910 census, are hay, oats, potatoes, rye, corn, and barley, with buckwheat, wheat, peas, and beans as crops of lesser importance. While the dairy industry is important it is not as highly developed as in some of the adjoining counties where there is a larger proportion of heavy soils.

Practically all of the crops grown may be considered in part as cash crops, for hay, corn, oats, rye, and barley are sold to some extent directly from the farm. Potatoes are grown mainly for sale, although they are one of the most important subsistence crops. The greater part of the hay, corn, oats, and barley produced is used in feeding live stock, and much of it finally reaches the market in the form of dairy products, beef, and pork. A considerable quantity of grain and hay is used as feed for work stock.

Hay is grown more extensively than any other crop. The 1910 census reports 48,286 acres in all hay crops, with a production of 47,982 tons, or nearly 1 ton per acre. About 75 per cent of the tame hay grown consists of mixed clover and timothy. Little clover is grown alone. Minor hay crops are wild hay, small grains, millet, and alfalfa. The best hay crops are produced on the heavy soils of the Spencer, Gloucester, and Merrimac series. As most of the soils are acid, alsike clover is sometimes grown in place of red clover. Red clover does well on land whose productiveness has been kept up and succeeds on new land in spite of the acidity, but on run-down fields it is not very successful.

In 1909 oats were grown on 37,838 acres, with a total production of 697,853 bushels. This crop gives best results on the fine sandy loams, loams, and silt loams. It is often grown on some of the light sandy soils, but with unsatisfactory results.

Potatoes in 1909 occupied 30,637 acres, giving a total production of 2,508,521 bushels. This crop is grown successfully throughout the sandy areas of the county, but best yields are obtained where there is sufficient clay in the soil to make it some what loamy. Potatoes are grown in all parts of the county and to some extent on practically all the soils.

Rye was seeded on 19,858 acres in 1909, and produced 222,333 bushels. Rye is grown most extensively on the sandy soils, and it gives better results on the extremely sandy types than any of the other small grains.

The total area in corn in 1909 was 15,834 acres, and the production amounted to 394,189 bushels.

Barley is grown to a small extent. In 1909 this crop was grown on 1,184 acres, and produced 25,652 bushels. The acreage of barley has apparently increased somewhat during the last few years.

Wheat is grown only to a very small extent, although at one time it was the most important crop in the county. Buckwheat is grown in various parts of the county, chiefly on the marshy tracts where the drainage conditions have been improved. Peas and beans are grown to a limited extent.

Some trucking is done in the vicinity of Stevens Point. On most farms small plots are devoted to cabbage, lettuce, radishes, onions, strawberries, brambleberries and other vegetables and small-fuit crops for home use. The sandy soils are probably better adapted to trucking than to any other line of farming.

The following table shows the acreage and production of the principal crops in the last four census years:

Croy	1879		1889		1899		1909	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	12,131	278,749	14,489	403,088	17,289	388,100	15,834	394,189
Oats	9,749	225,614	24,453	739,527	32,878	734,080	37,838	697,853
Wheat	21,853	204,778	4,342	54,814	6,373	85,910	397	5,376
Rye	10,144	111,659	15,151	186,155	20,409	217,780	19,858	222,333
Barley	965	16,544	471	12,779	421	7,550	1,184	25,652
Buckwheat	723	3,819	1,607	19,086	983	9,270	496	3,859
Potatoes	.....	213,570	12,094	1,324,761	29,099	1,978,344	30,637	2,508,521
Peas	.....	782	.....	7,560	417	6,608	319	1,799
Beans	.....	1,210	.....	1,451	43	379	52	480
		Tons		*Tons*		*Tons*		*Tons*
Hay	16,346	13,470	29,388	30,203	36,884	43,444	48,286	47,982

Fruit growing receives little attention in Portage County, since a large proportion of its area is not well adapted to this industry. Apples are grown more extensively than any other fruit. On many of the farms there is a small orchard which usually supplies apples for home use and in some years a surplus to sell. Apples do best over the eastern and northeastern

parts of the county, where the surface is more or less rolling. The level tracts of sandy soil are not suited to this fruit.

The raising of live stock is an important industry. The 1910 census reports 31,378 head of cattle, 9,255 horses, 13,264 hogs, and 5,075 sheep in the county. In 1909 there were 7,954 calves sold or slaughtered, 5,415 other cattle, 13,980 hogs, and 2,198 sheep. Animals sold or slaughtered in that year amounted in value to $413,564. Most of the calves and steers sold are from dairy herds. Hogs are raised in conjunction with dairying and general farming. Hog raising is not as well developed in this county as in sections where more corn is grown.

There were 18,783 dairy cows in the county in 1910, and the dairy products of the preceding year, exclusive of those used in the home, had a value of $606,348. There were 27 creameries and 3 cheese factories in the county in 1913. Milk and cream are sold at retail in the towns in a small way. Dairy cows of Holstein breeding are more numerous than those of any other breed. The use of purebred sires is gradually improving the stock.

Differences in the character of the soil in various parts of the county have some influence upon the distribution of the crops. Oats are grown more extensively on the heavier soils than on the sandy types, while potatoes are more profitable on the sandy types than many other crops. Rye is grown most extensively on the light-textured soils and gives better results on this class of land than do the other small grains. The dairy industry is most successfully developed on soils which have a texture as heavy as or heavier than a fine sandy loam.

The general methods of farming followed are about the same as those practiced throughout the general farming and dairying districts of Wisconsin. The silo is in quite common use on dairy farms, and a considerable part of the corn crop is handled as ensilage. The hay crop is mostly stored in barns or stacked and used mainly as feed for stock. In potato growing modern machinery is in common use, and where the acreage will justify their purchase most farms are supplied with horse-drawn planters, diggers, and spraying outfits. In all lines of farming modern machinery is in common use on most of the farms. The farm buildings vary greatly in quality. On the extremely sandy soils the buildings are frequently inferior and

in poor repair, while those on sandy loam and heavier soils are much better. The barns are usually equipped with large hay forks or slings for use in unloading hay. The work stock and implements are not as heavy over most of the county as in many other parts of Wisconsin, since most of the soils are sandy and easy to cultivate.

A rotation quite commonly followed on the sandy soils consists of small grain followed by clover and this by potatoes. The second crop of clover in a few cases is plowed under as a green-manure crop. On the extremely sandy types it is desirable to arrange the system so that the ground may be covered as much of the time as possible to prevent drifting, which often causes considerable damage to growing crops. In some cases so much of the soil is blown away that the seed is left exposed. On the heavier soils the usual rotation is somewhat different from that on the lighter types. Here corn more frequently takes the place of potatoes, and the land is usually left in grass for hay for two years and frequently is pastured for one year before again being plowed. On neither the sandy nor heavy types has the question of crop rotations been given careful study.

Stable manure is the fertilizer used most extensively, but the supply of this is not sufficient to meet the requirements of the soil. Commercial fertilizers are not in common use. They are used mainly on the marsh soils, especially in the vicinity of Coddington. The peat soil is deficient in potash and phosphorus and is also acid. A large tonnage of wood ashes was recently applied to peat soils near Coddington at the rate of about 1,000 pounds per acre. A considerable amount of rock phosphate is used in the county, usually at the rate of about 1,000 pounds per acre. Acid phosphate is in some instances applied by itself or along with the rock phosphate. The use of ground limestone for correcting soil acidity is coming to be recorganized as profitable, and a number of farmers both on the peot soils and on the uplands have tried liming, with success. Trials with mixed commercial fertilizers have been made in several instances, especially on potatoes, with satisfactory results.

The supply of farm labor is fairly good. In many cases women and children assist with the farm work. Where hands are hired for the year or by the month the wage usually ranges

from $25 to $50 a month, depending upon the experience of the laborer. Married men are usually given fuel and the use of a house and garden. During haying and harvest periods, when extra day help is often needed, the wage is usually $1.50 to $2 or more a day.

The average size of farms in Portage County as given by the census of 1910, is 127 acres. In the marshy areas and in the least developed parts of the county land is frequently held in large tracts. In 1910 there were 3,229 farms in the county, comprising 79.1 per cent of its total area. Each farm has on an average 68 acres of improved land. Practically 90 per cent of the farms are operated by the owners.

In 1900 the average assessed value of land in the county was $13.47 an acre. By 1910 this had increased to $27.94 an acre. Where general farming is most highly developed, on the heavier soils, land values frequently reach $100 an acre. Comparatively few farms have a higher value than this. On the extremely sandy soils many partly improved farms can be bought for $20 to $40 an acre. On reclaimed marsh land farms sell for $30 to $70 an acre, the price depending largely upon the improvements, drainage, and location. Cut-over land in the undeveloped sections may be bought for $18 to $30 an acre. Unimproved marsh land, where no effort has been made toward reclamation, is usually of lower value than any other character of land in the county.

CHAPTER VIII

CLIMATE

Among the factors which influence the agriculture of a state none is more important than climate. The class of crops which can be grown is largely determined by the length of the growing season, and the amount and distribution of the rainfall. Any one of these factors may determine the type of farming which can be followed to best advantage.

The distribution of rainfall over Wisconsin is remarkably uniform, the average yearly precipitation having a range of from 28 to 34 inches, while the mean for the state as a whole is 31 inches.

The local distribution of rainfall varies, however, from year to year in different sections. The variation is caused largely by the movement of cyclonic storms. The average rainfall for the entire state during the driest year was 21.4 inches, and for the wettest year 37 inches.

Of equal importance in agriculture to the total rainfall is its seasonal distribution, and in this respect Wisconsin is usually fortunate, since about half of the total rainfall comes in May, June, July and August, and nearly 70 per cent from April to September, inclusive. June has the heaviest rainfall, averaging 4.1 inches, while July averages 4 inches, and May 3.9 inches. The average rainfall for the state during winter is 3.9 inches, during spring 8.3 inches, during summer 11.4 inches, and during autumn 7.4 inches. The small winter precipitation in Wisconsin, mostly in the form of snow, on the other hand, causes virtually no leaching of fertility from the soil or erosion.

The climatic conditions prevailing in Portage County are somewhat variable owing to differences in topography and soil. In the southwestern part of the area there are extensive marsh areas, most of which have been reclaimed. Throughout the valley of the Wisconsin River, which traverses the western side

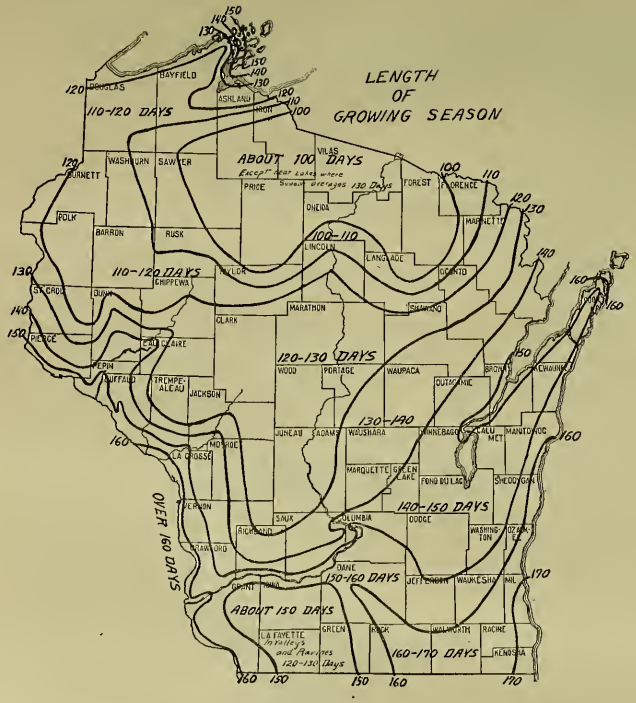


Fig. 2. Map showing length of growing season for corn.

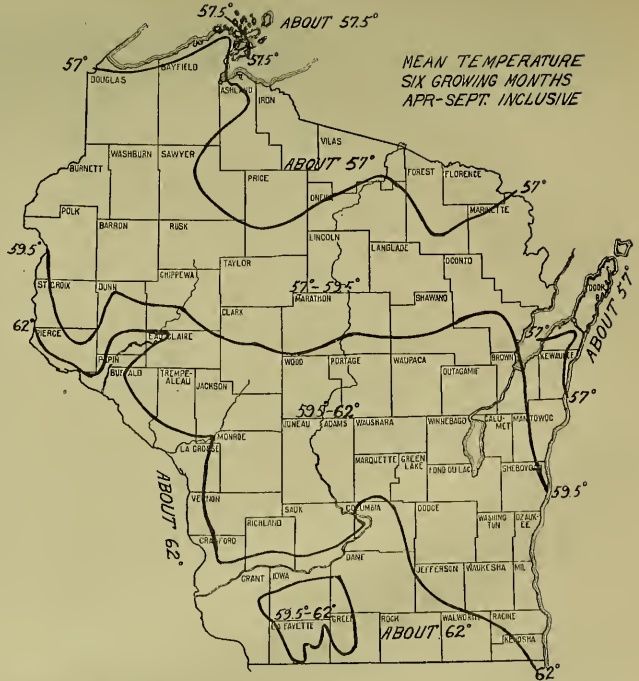


Fig. 3. Map showing average temperature for the six growing months April to September, inclusive. Note that the difference between the average temperature for the areas surveyed, and the southern portion of the State is only slight, varying from 2.5 to 5 degrees.

of the county, and also along part of the southern border, there are extensive sandy spots, with marshy tracts frequently intervening. Throughout the northeastern, east-central and extreme northwestern parts of Portage county the surface is gently rolling to rolling and danger from late spring and early fall frosts is not as great as over the lower lying sections of the area.

Two weather bureau stations of long standing are located within the area. The station at Stevens Point is near the Wisconsin River and records from this place are representative of conditions prevailing over the extensive level sandy terraces throughout the county. The station at Amherst is situated in a more rolling country and represents the upland portion of the survey. No records are available from the extensive marsh tracts, but is is probable that the marshes have a somewhat shorter growing season than the remainder of the county.

The following table gives the Normal, Monthly, Seasonal and Annual Temperature and Precipitation as Recorded at Two Stations Within the County.

Month	Stevens Point (Elevation 1 113 ft.		Amherst (Elevation 1.290 ft.)	
	Temperature F°	Precipitation inches	Temperature V°	Precipitation inches
December	19.0	1.26	19.4	0.63
January	14.8	1.04	14.1	1.27
February	13.9	0.85	14.3	1.28
Winter	15.9	3.05	15.9	3.98
March	29.4	1.39	27.9	1.78
April	44.6	1.52	43.8	2.61
May	56.2	4.00	55.1	4.07
Spring	43.1	8.09	42.2	8.46
June	65.5	4.17	64.9	4.29
July	69.6	3.40	69.6	3.63
August	67.5	2.89	67.3	3.22
Summer	67.5	10.46	66.9	11.18
September	60.4	3.34	6.00	3.25
October	47.9	2.53	47.7	2.60
November	32.7	1.73	31.7	1.70
Fall	47.0	7.59	46.5	7.55
Year	43.4	29.10	43.0	31.37

DATA OF LAST AND FIRST KILLING FROSTS.

Station	Length of Record Yrs.	Average date of		Average length of growing season.
		Last killing frost in spring	First killing frost in fall	
Stevens Point.....	7	May 25	Sept. 26	123
Amherst.....	18	May 22	Sept. 27	127

It will be observed from these tables that Stevens Point has a mean annual precipitation of 29.1 inches, and Amherst 31.37 inches. It will also be observed that a large proportion of the rainfall comes during the growing months when most needed. For the six months from April to September inclusive there is an average monthly rainfall of over 2½ inches. Although the rainfall is normally well distributed there are frequently dry spells, especially during July and August, during which crops suffer from lack of moisture.

The winters in this region are long and severe with a snowfall of 41 inches, but the summers are pleasant and farm crops make rapid growth. Storms of a destructive nature are very rare in this region. There is an abundant supply of excellent water, which is readily obtainable for both man and beast. The climate is healthful and well suitable to a very high development of agriculture.

SUMMARY

Portage County is situated in the central part of the State of Wisconsin. It comprises 812 square miles, or 519,680 acres. The surface features vary from level to rolling and hilly. The average elevation of the county above sea level is about 1,110 feet.

The eastern third of the county drains toward the east through tributaries of the Little Wolf and Waupaca Rivers into Lake Michigan, while the remainder of its area drains into the Wisconsin River, and thence into the Mississippi.

Portage County was organized in 1844. The early settlers came largely from eastern States. The total population in 1910 was 30,495. The population is 71.9 per cent rural. Stevens Point, the county seat, with 8,692 inhabitants, is the only place with a population larger than 1,000. Portage County has good railroad connection with many large cities and markets.

The soil material of Portage County has been derived from glacial, residual, and alluvial materials. The soils have been classified into 14 soil series and 24 soil types, each of which has characteristics by which it can be recognized.

The agriculture of the county shows all stages of development. The best farming land is in the northwestern, northeastern, and eastern parts of the county, where fine sandy loam or heavier soils predominate. Soils of lower value, mostly sandy or marshy, occur throughout the central, southern, and north-central sections.

The principal crops are hay, oats, potatoes, rye, corn, barley, and buckwheat. General farming is the prevailing type of agriculture, and dairying and potato growing are two of the most important interests.

Over 79 per cent of the total area of the county is in farms. The average size of the farms is 127 acres, of which on an average 68 acres are improved. About 90 per cent of the farms are operated by owners.

The mean annual precipitation for the county is about 30 inches, and the mean annual temperature is about 43° F. The

winters are long and severe, with a snowfall of about 41 inches, but the summers are warm and crops make rapid growth. There is a growing season of about 125 days free from killing frosts.

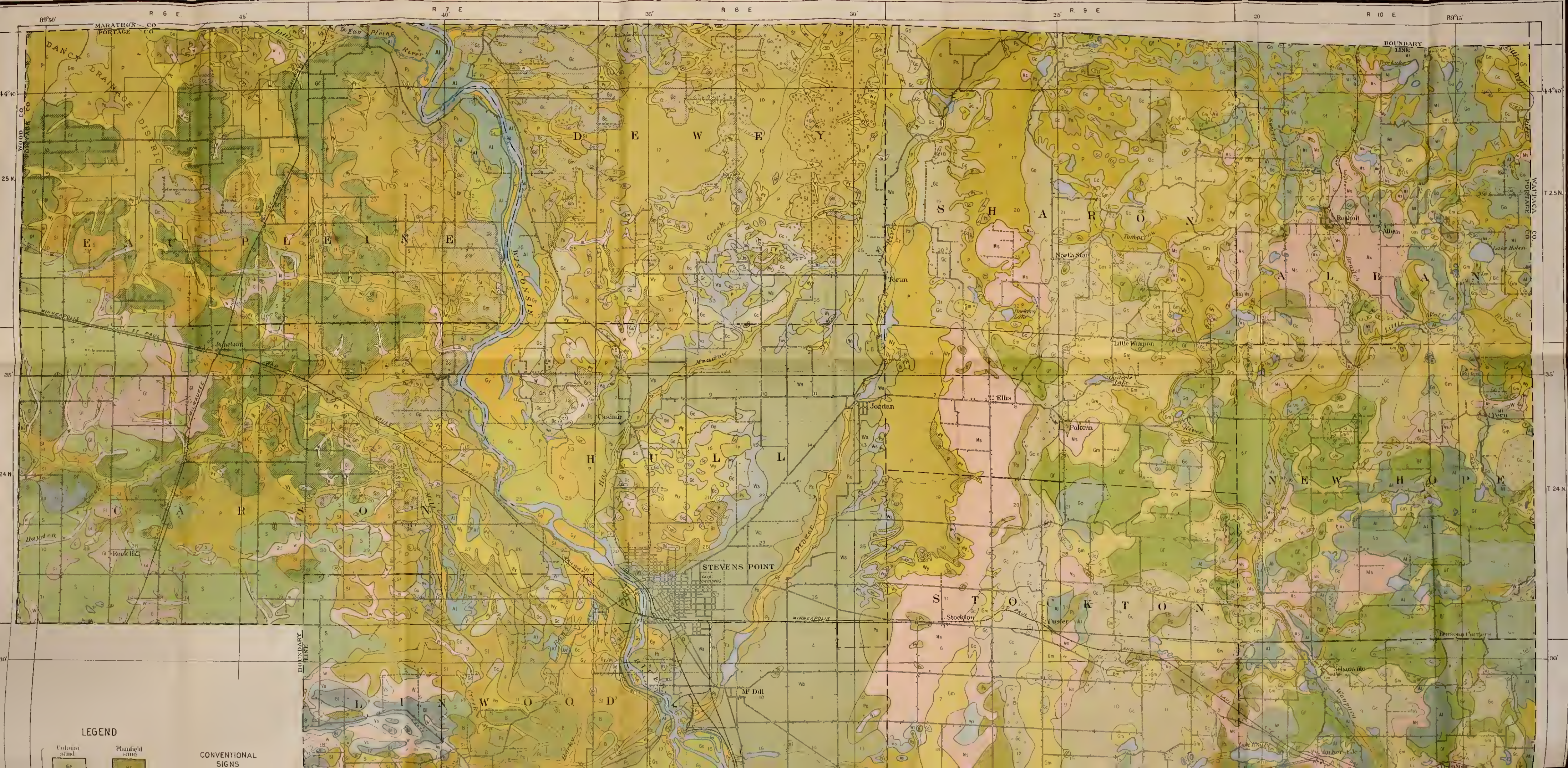
KEEP THE MAP

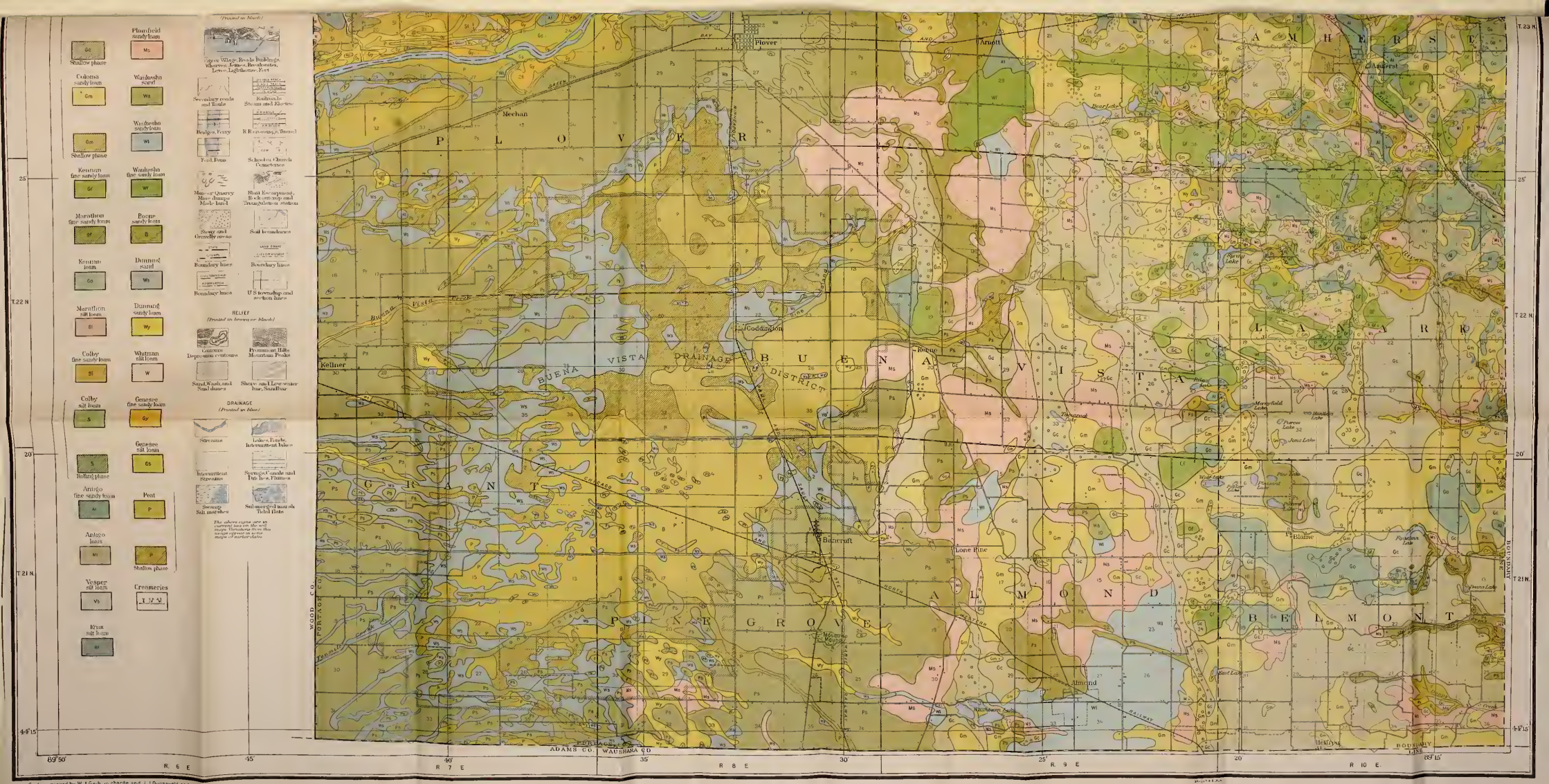
The Experiment Station will publish bulletins from time to time dealing with the management of the different types mapped, so that some way should be found by each person receiving a copy of this report to keep the map permanently. If the map is folded in such a way as to have the part you are interested in of a convenient size, and then have a simple frame with glass made to hold it, it can be kept indefinitely. Since some of the colors fade after being exposed to strong light for a long time, it would be a good plan to have a protecting flap of dark cloth over the map when not in use.

U S DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
CURTIS F MARBUT, IN CHARGE SOIL SURVEY
THOMAS D RICE INSPECTOR, NORTHERN DIVISION.

SOIL MAP
WISCONSIN
PORTAGE COUNTY SHEET

STATE OF WISCONSIN
GEOLOGICAL AND NATURAL HISTORY SURVEY
E A BIRGE, DIRECTOR
COLLEGE OF AGRICULTURE, UNIVERSITY OF WISCONSIN.
H L RUSSELL, DEAN
A R WHITSON, IN CHARGE SOIL SURVEY





Soils surveyed by W J Geib, in charge, and J J Dunnewald, and Lewis P Hanson, of the Wisconsin Geological and Natural History Survey and L R Schoenmann, of the U S Department of Agriculture